

CONFIDENTIAL

**(DRAFT)
PROPOSAL TO**

OUTBOARD MARINE CORPORATION

for

**PROCESSING
PCB CONTAMINATED SEDIMENTS**

at the

WAUKEGAN, ILLINOIS FACILITY

using

THE B-E-S-T-III PROCESS

DECEMBER 1987

**Resources Conservation Co.
Bellevue, Washington**

RCC PROPOSAL NO. 87-5001

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1.0 B.E.S.T.TM TREATMENT OF PCB CONTAMINATED SEDIMENTS

PCB cleanup of harbor sediments by traditional means has proven difficult and expensive. The generally accepted method for cleanup of PCB contaminated sediments is incineration, which is very costly. Most other PCB destruction technologies are limited by the presence of water and solids. Basic Extractive Sludge Treatment (B.E.S.T.TM), is a proven, patented technology used to separate difficult to handle mixtures. Water and/or solids in the material do not limit extraction efficiency of the B.E.S.T.TM process.

B.E.S.T.TM can be used as a waste reduction technique prior to PCB destruction. The PCB/oil fraction extracted from the sediment is virtually free of water and solids, suitable for further treatment. The water and solids fractions are low in residual PCB's. PCB's in the water fraction typically are below detectable levels (less than five parts per billion). The concentration of residual PCB's in the treated solids is a function of the number of extraction steps. Typical two stage extraction efficiency of PCB's from sludge exceeds 99%.

The B.E.S.T.TM solvent extraction system utilizes a unique property of an aliphatic amine solvent (triethylamine, [TEA]) to separate sludges and sediments into their oil, water, and solids fractions. The physical properties of TEA can be used to overcome the typical solvent extraction difficulties when handling samples with high water content. The key to the success of triethylamine extraction is the property of inverse miscibility. At temperatures below 65°F, TEA is perfectly soluble with water. Above this temperature, TEA and water are only partially miscible.

The miscibility properties of triethylamine can be utilized without extreme physical conditions. Temperatures of liquid streams within the unit vary from about 32°F to 140°F, and high pressures are not required. A nitrogen blanket is used within the system. The nitrogen blanket creates a small positive pressure on tanks and vessels. Also, the full scale system uses standard process equipment. Figure 1-1 is a process flow block diagram of the B.E.S.T.TM system.

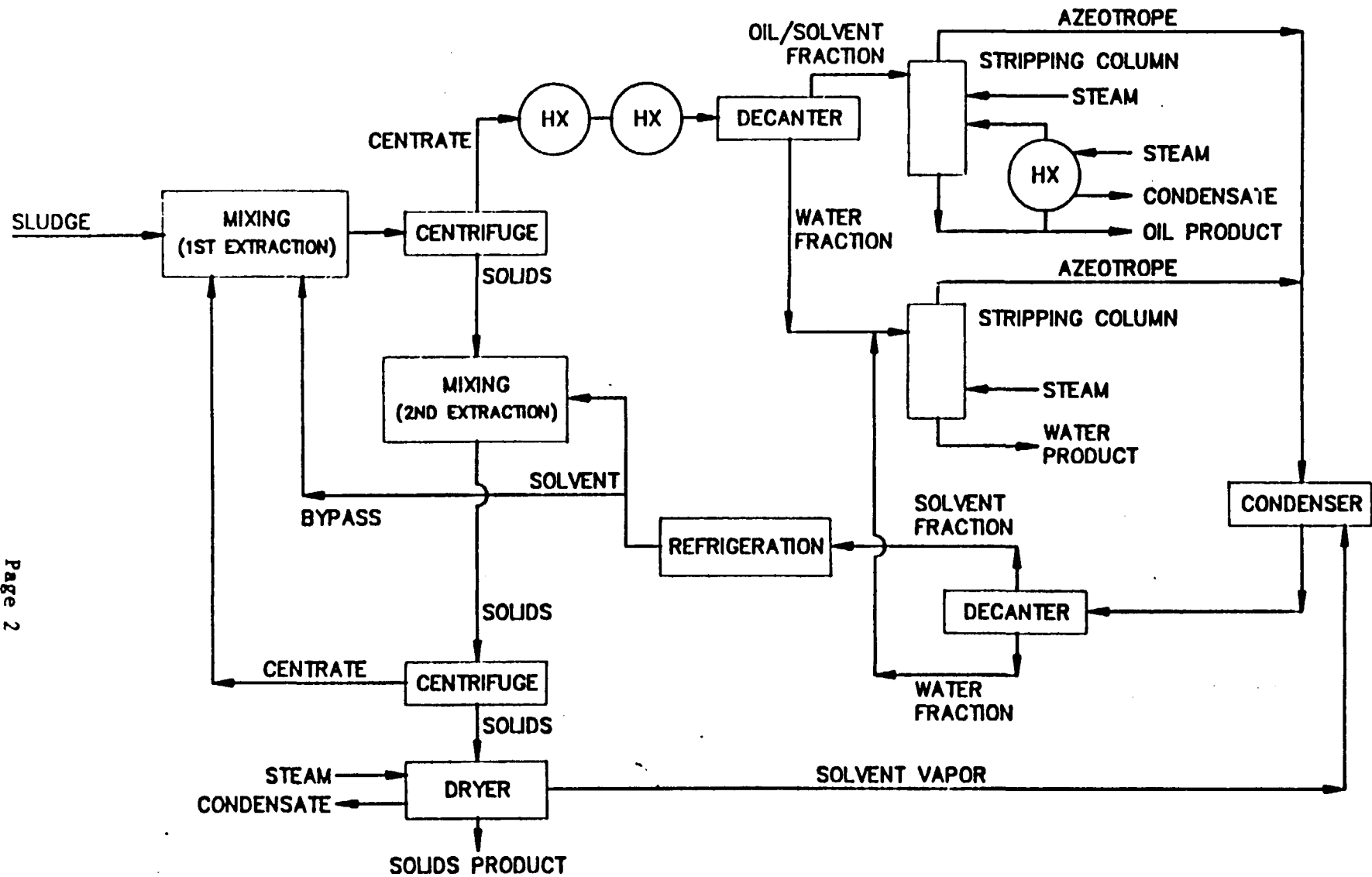


FIGURE 1-1
B.B.S.T.™ PROCESS FLOW DIAGRAM

1.1 Laboratory Testing of PCB Contaminated Sediments

A laboratory simulation of the B.E.S.T.TM process has been devised that closely approximates the operation and performance of the full scale solvent extraction system. RCC's 70 yd³ per day B.E.S.T.TM unit performance at the General Refining site allowed comparison of data obtained during laboratory simulation to data obtained during full scale processing. At that site, separation efficiency was better in the full scale unit than in the laboratory simulation testing.

Laboratory simulation of the B.E.S.T.TM process involves mixing of chilled TEA with a pH adjusted sample. The pH of the feed material must be kept slightly alkaline due to the chemical structure of TEA.

The mixing step is followed by centrifugation in a floor mounted centrifuge for particulate solids removal. The speed and duration of the centrifugation simulates conditions found in the full scale centrifuge. Solids recovered from centrifugation are washed with additional clean solvent. A two stage extraction is typically used unless data shows that additional wash steps are desired to increase the overall extraction of the particular component of interest. The single phase cold TEA/water/oil mixture is then heated and allowed to decant in a separatory funnel into an upper TEA/oil phase and a lower water phase. Stripping of the TEA from both the oil and water phases is typically accomplished in a rotovap apparatus at atmospheric pressure.

Recovered oil, water, and solids fractions from the glassware simulation are analyzed to determine PCB removal and phase separation efficiency. Methodology for the analysis of PCB's was taken from EPA's Test Methods for Evaluating Solid Waste SW-846. Additional items investigated routinely include residual TEA levels in the oil, water, and solids. Other parameters evaluated are the residual oil in the water and the oil in the solids as well as the particulates and water residuals in the oil as are heavy metals in each product stream.

Figure 1-2 shows the results of laboratory testing on a number of PCB contaminated materials, including sludges soils and sediments. Typical extraction efficiency is 99%. It may be substantially higher in some instances. Extraction efficiencies were calculated on the dry sample basis since PCB's are not appreciably water soluble. They are present in the oil component or bound to the particulates. Although PCB's are readily soluble in TEA, there is a fraction of the total amount that is not extractable during glassware simulation of the process. Figure 1-3 shows the results of multiple extraction stage testing undertaken on a PCB contaminated soil.

With typical PCB extraction efficiencies ranging from 98-99.9%, the PCB's are concentrated into the oil fraction that is extracted from the feed. The oil may then be dechlorinated or incinerated at a much lower overall cost than the entire sediment volume. Produced solids may be suitable for direct deposition in the environment. The produced water, if necessary, may be treated to remove oil & grease and metals before direct discharge.

1.2 B.E.S.T.TM Glassware Test Results with the Outboard Marine Corporation Supplied Samples (Preliminary)

Two gallons of 'Crescent Ditch Muck' and 'Crescent Ditch Sand' from the Outboard Marine Corporation site at Waukegan, Illinois were received by RCC personnel on 11/23/87. The chain of custody sheet included in the sample shipment showed that the samples were collected on 11/19/87.

The material was analyzed for Total Solids at 105°C to determine its volatile (i.e., water) and non-volatile fractions (i.e., solids + oil/heavy organics) at 105°C.

The dried sludge sample derived from the Total Solids determination was then placed into a Soxhlet extractor and extracted with methylene

PCB Concentration in Glassware B.E.S.T.TM Workups
(ppm unless otherwise noted)

Client	Type of Sample	Initial Concentration		Product Fraction Concentrations			%Extraction Efficiency (Dry Basis)	Extraction Steps
		(Wet)	(Dry)	Solids	Oil	Raw Water		
A.	Soil	1,500.	1,685.	19.	600,000.	N/A	98.9	6
B.	Spiked Sediment	124.		.082	N/A	N/A	99.9	6 hour Soxhlet
C.	Oily Sludge	1,300.	7,065.	47.	365,000.	1.6	99.3	2
D.	Oily Sludge	106.	189.3	.75	270.	N/A	99.6	2
E.	Oily Sludge (A)	51.	71.	2.7	80.	N/A	96.2	3
	Oily Sludge (B)	21.	27.	.30	71.	N/A	98.9	2
	Oily Sludge (C)	11.	13.	.06	52.	N/A	99.5	3
F.	Sediment (A)	22.	41.	1.9	5,300.	<.02	95.4	2
	Sediment (B)*	960.	1,157.	40.	N/A	N/A	96.5	5
G.	Oily Sludge (A)	68.	170.	1.1	190.	N/a	99.4	2
	Oily Sludge (B)	83.	138.	1.1	N/A	N/A	99.2	2
	Oily Sludge (C)	N/A	N/A	1.8	N/A	N/A	N/A	2

* 10% Hexane in TEA

FIGURE 1-2

PCB CONCENTRATION IN GLASSWARE B.E.S.T.TM WORKUPS

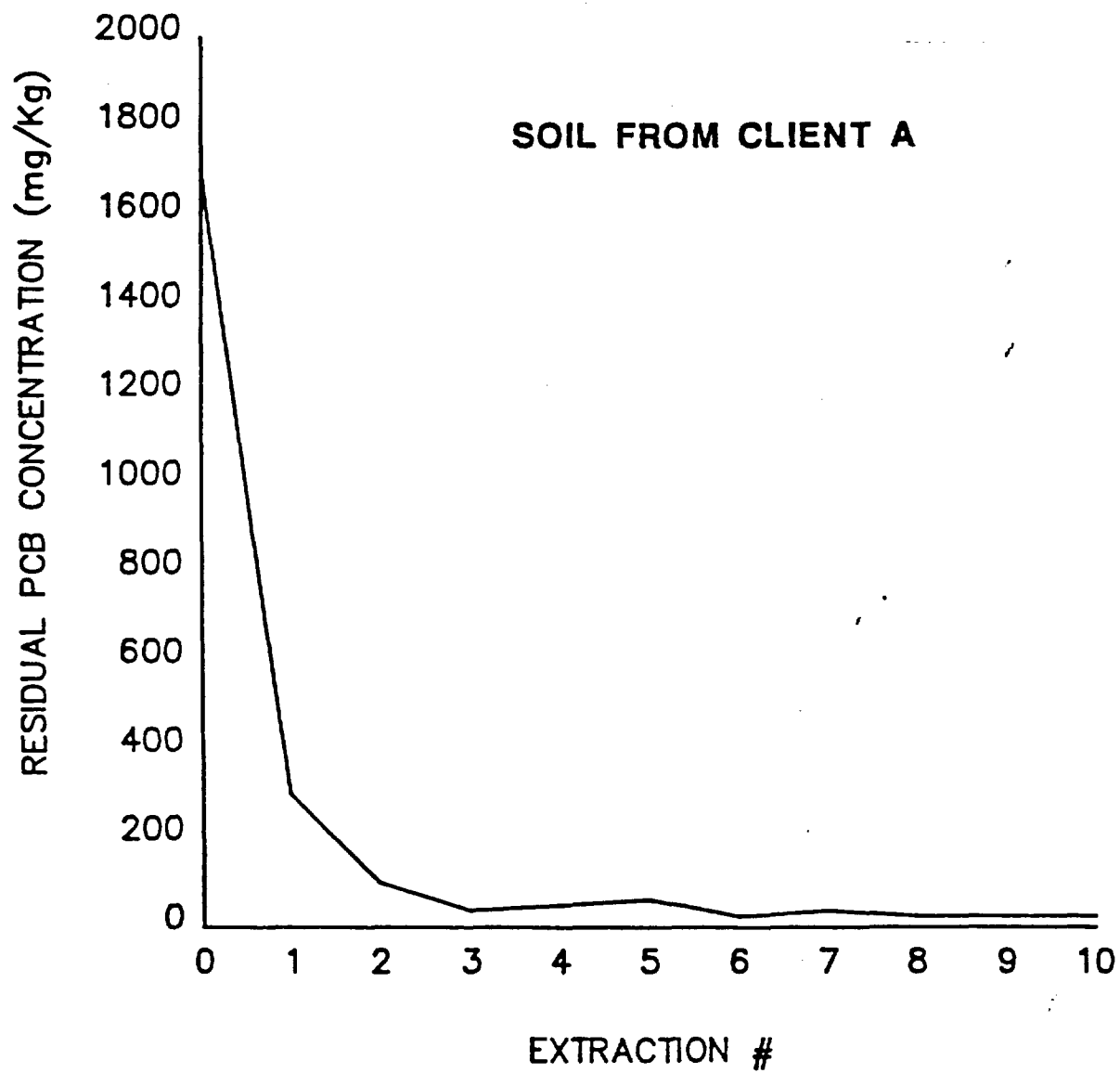


FIGURE 1-3
MULTIPLE TEA EXTRACTION ANALYSIS

chloride overnight to gravimetrically determine oil content. The solids were determined by difference. In addition, the samples were tested for total PCB content by Soxhlet extraction followed by GC/ECD. The results of these analyses were as follows :

<u>Analyte</u>	<u>Results</u>	
	<u>Muck</u>	<u>Sand</u>
Oil %	11.	3.
Water %	60.	22.
Solids %	29.	75.
PCB's (mg/kg)	179,000.	26,000.

The apparent discrepancy between the oil content and PCB content on the muck sample may be due to the fact that the oil result was obtained by MeCl_2 extraction and the PCBs were determined by hexane; acetone extraction as outlined in EPA's SW-846. Further work is currently underway to resolve this apparent discrepancy.

A portion of both samples was ashed at 550 degrees Centigrade and then digested in nitric acid. They are currently being analyzed for heavy metals content.

The sediment pH must be adjusted to about 11 to prevent ionization of the TEA solvent. The pH of the Muck sample was 6.3 and the pH of the Sand sample was 6.6, therefore pH adjustment was needed. Caustic soda was added to elevate the sample pH. The amount of caustic required was equivalent to 8.7 and 1.8 mls of 50% caustic per kilogram of Muck and Sand samples, respectively.

Five parts by volume chilled TEA was added to the chilled samples along with the proportionate amount of caustic soda determined from the sludge pH adjustment testing. Mixing was performed by a pneumatic mixer in a beaker for 30 minutes. The solvent became dark colored indicating that oil was being extracted.

The treated solids have the following composition:

Product Solids Analysis
(two stage extraction)

<u>Analyte</u>	<u>Muck</u>	<u>Sand</u>
Residual Triethylamine	TBD	TBD
Residual Oil and Grease (freon)	0.13 %	0.03%
Residual Oil and Grease (MeCl ₂)	0.24%	0.02%
Residual PCB's (mg/kg)	780.	48.

A portion of each as received sample was also extracted with TEA in a Soxhlet apparatus to determine the maximum PCB extraction efficiency. The TEA extracted samples were then analyzed for PCB's with the following results:

	<u>Muck</u>	<u>Sand</u>
PCB's	71. ppm	25. ppm

As can be seen from Figure 1-3, optimum extraction efficiency is achieved after three or four extraction stages, indicating that a third extraction step should easily reduce the residual PCB's in the "muck" sample product solids below 500 mg/kg.

The foregoing residual PCB's are from samples very high in PCB's. OMC indicated that the average level of PCB's in the 15,000 yd³ total would be closer to 8,000 ppm. Based on this lower level of PCB's and the average PCB extraction efficiency of the two samples tested, the predicted PCB residual after two stage extraction would be about 25 ppm.

Both total metals analysis and EP Toxicity leachate metals analysis are currently in work.

Decantation performance was good. A distinct separation of the water and TEA fractions was observed with both samples and no 'rag' formed with either sample.

The product water fractions had the following characteristics;

Product Water Analysis

<u>Analyte</u>	<u>Muck</u>	<u>Sand</u>
Final pH	10.8	10.5
Total Organic Carbon (mg/l)	3,300.	2,400.
Total Solids (mg/l)	5,800.	2,500.
TEA (mg/l)	TBD	TBD
PCB (mg/l)	TBD	TBD

Additional analyses of the water are being conducted to determine if the water fraction can be sent directly to the local Publicly Owned Treatment Works (POTW). The additional analyses include; cadmium, total chromium, copper, lead, nickel, silver, zinc, and oil & grease. If required, RCC can process additional sediment and analyze the product water for total dissolved solids, suspended solids, cyanide, total phenol and ammonia. RCC understands that OMC will determine if the product water is suitable for direct discharge to the local POTW.

Product Oil analysis is currently in work.

2.0 B.E.S.T.TM TREATMENT OF PCB CONTAMINATED SEDIMENTS AT OUTBOARD MARINE CORPORATION'S WAUKEGAN, ILLINOIS FACILITY

2.1 Sediment Compositions and Volumes

As discussed in Section 1.2 - B.E.S.T.TM Glassware Test Results, the "muck" and "sand" samples provided by Outboard Marine Corporation have the following composition:

	<u>"Sand"</u>	<u>"Muck"</u>	<u>60/40 Composite</u>
Oil*	3%	11%	6%
Water	22%	60%	37%
Solids	75%	29%	57%

* Methylene Chloride soluble

Outboard Marine Corporation estimates that the sediment to be treated has an overall composition of 60% "sand" and 40% "muck" by volume.

2.2 Project Scope of Work

2.2.1 RCC Scope of Work

The battery limits, conditions and scope of work for which RCC proposes to be responsible is as follows:

- o Provide sediment storage of 280 yards for front-end processing and feed surge capacity.
- o Screen feed materials to 1/2 inch maximum dimension and return oversize screenings to others.
- o Install and operate a B.E.S.T.TM system to treat the sediments.
- o Produce a solids residual from processing at the B.E.S.T.TM battery limits. Solid product from the B.E.S.T.TM process will be transferred by RCC in two-yard enclosed special purpose "dumpsters" to a transfer truck, rail car, or other facility defined and operated by others.

- o Provide the product water at the site battery limits for removal and disposal by others. RCC will provide storage of the product water if needed to support requirements for discharge testing or convenience.
- o Provide the extracted PCB/oil to a 2500 gallon product oil surge tank prior to transfer to a rail car or trailer truck for shipment to an approved incineration facility. The rail siding adjacent to the parking lot is assumed to be available for this purpose.

2.2.2 Work Scope of Others

- o Excavation, bulk dewatering, and transfer of sediments to any bulk storage facility adjacent to the B.E.S.T.TM system battery limits.
- o Removal from the sediments of all material (i.e., stones and large trash) which measure more than 1" maximum dimension.
- o Disposal of B.E.S.T.TM product water.
- o Disposition of materials screened out of the feed by RCC. (See Section 2.2.1)
- o Receive and dispose of the B.E.S.T.TM product solids.
- o Provision of required utilities at the site battery limits.
 - Service Water (Potable OK) @ 7.5 gpm and 50 psig constant flow with a periodic requirement of up to 30 gpm and 50 psig for a gross average flowrate of approximately 8 gpm.
 - Cooling Water (Lake Michigan - once thru) at a maximum flowrate of 700 gpm and 25 psig.

- Provision of a fire hydrant within 50 feet of the unit battery limits. (With booster pump, cooling water header should be sufficient for local authorities if source is uninterruptible.)
- Electrical Power, connected load - 700 kW at 480VAC.
- Supply to RCC of No. 2 Oil from OMC inventory for boiler operation would be convenient but RCC willing to supply on local contract. Estimated requirements for boiler operation will be approximately 60 gallons per hour
- o Extension of the existing rail siding (if required for PCB oil shipment) to a position immediately adjacent to the process unit and any associated spill containment around such siding.

2.3 RCC's 100 yd³ per day B.E.S.T.TM Unit

For treatment of PCB contaminated sediments at the Waukegan facility, RCC proposes a modular, transportable B.E.S.T.TM unit with a nominal daily capacity of 100 yd³ per day and a maximum design capacity of 130 yd³ per day with a "typical" sludge specific gravity of 1.2. The actual OMC composite sludge as described in 2.1 has a specific gravity of 1.56 and therefore the actual nominal and design capacity of the "Waukegan" sediments will be 76 yd³/day and 99 yd³/day respectively. On an annualized basis, the 100 yd³ per day unit will be designed to process a daily average of at least 76 feed yd³/day. Experience from the commercial operation of a 70 yd³/day B.E.S.T.TM unit at the General Refining Superfund site is incorporated into the design of this new unit.

The B.E.S.T.TM unit designed for this project will be similar the to 70 yd³/day B.E.S.T.TM unit used for the General Refining, Inc. site cleanup. The front end will be specially designed to accommodate the high sand loading of the Waukegan sediment. Process elements will be assembled on 5-6 modules which will be transported to the site by truck or rail. Additional support modules will also be provided as required.

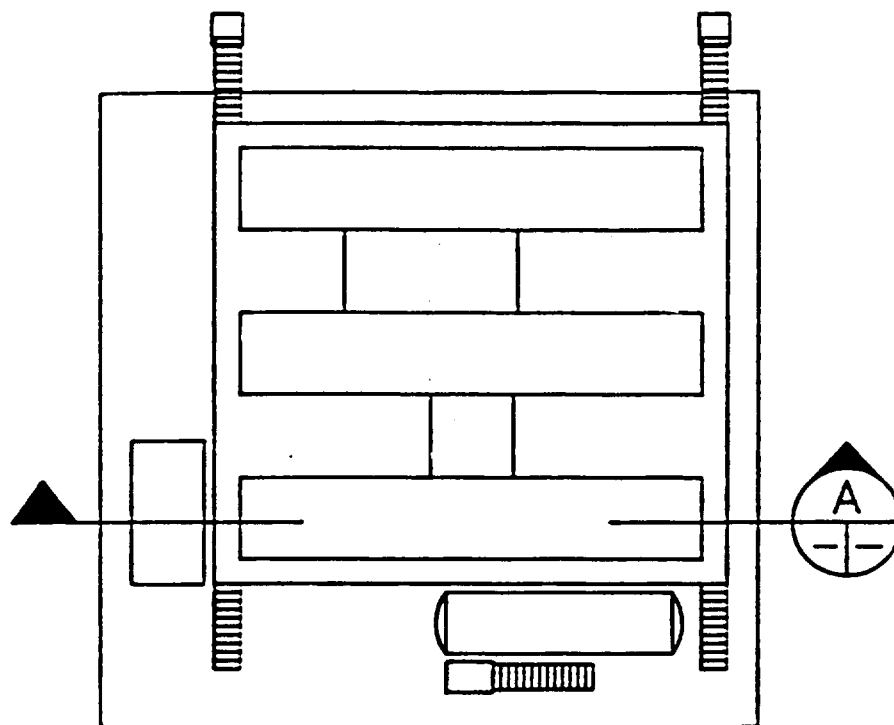
The system will be designed and built to accept the "sand" and "muck" into a sealed counterflow solvent extraction unit consisting of a series of tanks, mixers and pumps or conveyors, a solids dryer, vapor condenser, a solvent cooling system and separate solvent recovery system. This system will accept solids with solids up to 1/2" maximum dimension. Prior to entering the system all material will be screened with vibrating Sweco type screen to the 1/2" maximum dimension with the reject returned to the battery limits for disposition by others.

Process units will occupy an area measuring approximately 60' by 60'. Modules will have pans for spill capture (secondary containment) and a closed spill containment system. A curbed concrete slab will be prepared on the site for tertiary containment. Figure 2-1 shows the levels of containment incorporated into the process unit. All material collected in the containment area is recycled to the unit for reprocessing.

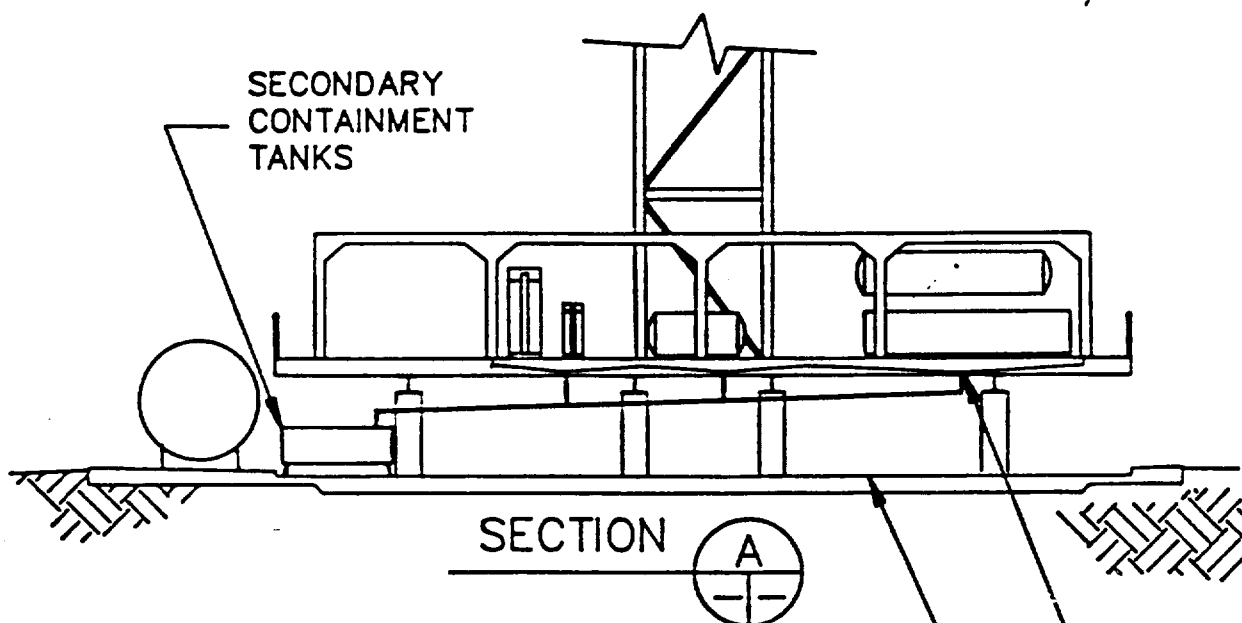
RCC will provide modules containing all required support equipment and systems. A 1/2 acre plot should provide adequate space for all RCC-provided items. The proposed site for the B.E.S.T. unit is discussed in Section 2.5. A projected list of modules to be provided includes the following:

- o 5-6 B.E.S.T.TM Process Unit Modules
- o 1 Boiler Trailer
- o 1 Control Room/Electrical Equipment Trailer
- o 1 Analytical Laboratory/Safety Equipment Trailer
- o 1 Spares and Maintenance Trailer
- o 1 Change Trailer
- o 1 Office Trailer
- o 1 Maintenance Trailer
- o 1 Nitrogen System/Refrigeration Trailer
- o 4 Skids for Screening and Sediment Storage

RCC toured the Waukegan site on November 20, 1987 and determined there is ample space for positioning all the required equipment and facilities without interfering with lagoon excavation and closure operations.



PLAN VIEW B.E.S.T.™ UNIT



TERTIARY CONTAINMENT: CONCRETE SLAB WITH
STEPPED SECTION SLOPED TO SUMP.
CONTAINMENT VOLUME 7000 GALLONS

SECONDARY CONTAINMENT: STEEL CATCH PANS WITH DRAINS
UNDER ALL PRIMARY CONTAINMENT VESSELS, PUMPS,
ETC. PAN DRAINS ARE HARD PIPED TO SECONDARY
CONTAINMENT TANKS.
CONTAINMENT VOLUME 3600 GALLONS

SPILL CONTAINMENT
SYSTEM

FIGURE 2-1

The B.E.S.T.TM unit requires the following utilities:

- o Steam 100-150 psi
- o Electricity 480 volt, 3 phase AC
- o Cooling Water 60°F
- o Nitrogen 100 psig
- o Service Water 50 psi
- o Instrument Air 80 scfm @ 100 psig

Electricity, cooling water and service water must be made available at the site. All other utilities will be provided from portable systems. Fuel oil for a portable steam boiler will be provided from No.2 fuel oil storage tanks at the Waukegan facility.

2.4 B.E.S.T.TM Processing

RCC will provide systems for moving sediments from storage into the screening and blending system. The blended material will be pumped directly into the B.E.S.T.TM process. The system will operate continuously, 24 hours per day, 7 days per week.

The B.E.S.T.TM unit will be designed for a capacity of 99 yd³/day of feed material of the composition noted in Section 2.1. For project life estimation purposes assume an average processing rate of 76 yd³/day. In other words the B.E.S.T.TM unit is expected to operate at design capacity 77% of the time during the 190 days projected for operation.

The B.E.S.T.TM process is totally enclosed. There is one small vent for non-condensibles in the solvent condenser system. Tests conducted in cooperation with EPA during RCC's operation at the General Refining site found no significant concentrations of contaminants leaving the vent system.

Maintenance operations may require opening closed elements of the B.E.S.T.TM system, thereby allowing some solvent to vaporize. Solvent losses to the atmosphere are kept to a minimum.

Solids produced by the B.E.S.T.TM process are very dry and can be dusty. Solids exiting the drier will pass through an enclosed chute into a container which is sealed with a resilient boot.

RCC personnel will include the following:

- o 5 Control Room Operators (including 1 backup)
- o 5 Outside Operators (including 1 backup)
- o 4 Materials Handling Personnel
- o 1 Operations Supervisor
- o 1 Safety Manager
- o 2 Laboratory Technicians
- o 3 Maintenance Technicians
- o 1 Secretary
- o 1 Site Administrator
- o 1 Site Manager

2.4.1 B.E.S.T.TM Performance Projection

B.E.S.T.TM processing of Outboard Marine Corporation sediments will result in a separation of these materials into distinct oil, water, and solids products. Glassware tests conducted on the sand and muck samples (Section 1) confirms the performance of the B.E.S.T.TM process on these materials.

The B.E.S.T.TM process will separate the materials described in Section 2.1 into the following approximate fractions:

- o Oil 36,000 gallons*
Bottom Sediment & Water (BS&W) < 2%
- o Water 2,200,00 gallons (average 10 gpm flowrate,
includes 4 gpm of steam added during final solvent
stripping)
O & G = TBD
TOC = ~2500 ppm
- o Solids 8490 tons
PCB <50 ppm

* Based on assumed feed oil content of 1% and the oil is 80% PCB.

2.4.2 PCB Oil Destruction

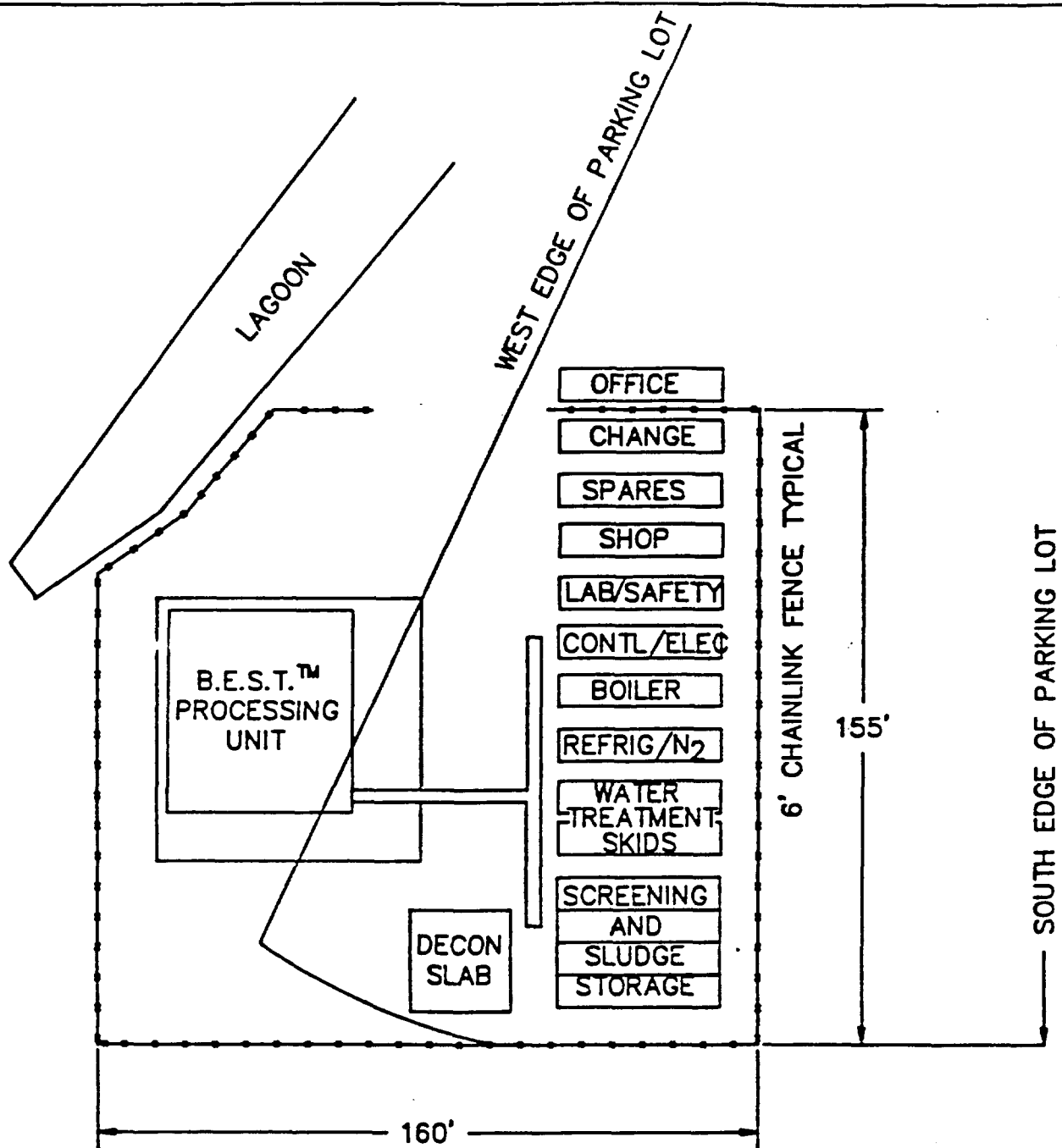
Incineration is the only EPA approved disposal method for liquid PCB's above a concentration level of 500 ppm. RCC has worked with 3 midwest TSCA approved PCB incineration companies to obtain costs for incineration of 36,000 gallons of waste PCB oil. Assuming that the oil would be supplied to the incineration facility in 6000 gallon lots and from March thru October of 1989 the cost to RCC would be 0.31 cents per pound of oil. The cost of burning the oil at an off site incinerator is \$130,000. Transportation cost for the oil is \$20,000. Total cost for oil destruction is \$150,000.

RCC proposes to negotiate the best-possible fixed price contract with an incineration firm, reflecting prevailing rates and regulations, as part of overall RCC/OMC negotiations in early 1988 should OMC elect to use the B.E.S.T.TM technology at the Waukegan site. These final disposal costs would be a direct pass-through cost to OMC.

2.5 Proposed Location for the 100 yd³ B.E.S.T.TM Unit at the Waukegan Facility

A preliminary site layout is suggested by Figure 2-2. An area of approximately 155' x 160' will be required to enclose the process unit and related support modules and offices. Because of safety considerations, a no smoking/no ignition source restriction is required within 100' of the processing unit. As a result, a somewhat larger area outside of the fenced enclosure will be posted accordingly.

Figure 2-2 locates the treatment facility at the southwestern corner of the parking lot on the assumption that this would minimize utility runs, be as far within the boundaries of the plant as possible, and be close to the railroad spur should this be determined to be the appropriate means for transporting the waste oil to an incineration facility.



PRELIMINARY B.E.S.T.™ SITE LAYOUT

SCALE: 1"=40'

NOTE: PERIPHERAL EQUIPMENT LOCATION IS FLEXIBLE AND ALLOWS FOR SOME ALTERATION OF SITE FOOTPRINT. FOR SAFETY CONSIDERATIONS A NO SMOKING, NO OPEN FLAME RESTRICTION IS REQUIRED WITHIN 100' OF THE PROCESSING UNIT.

FIGURE 2-2

2.6 Project Schedule

A suggested project schedule is presented in Figure 2-3. A go-ahead for the project is indicated in mid-March of 1988 with completion of the processing unit in February of 1989. The eleven months permitted for design and construction is very reasonable from past RCC experience and a proposed processing date of May 1, 1989 can be achieved.

2.7 Permitting Requirements

2.7.1 Onsite Operations

SARA § 121 (e) provides the following:

"Permits and Enforcement.--(1) No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite, where such remedial action is selected and carried out in compliance with this section."

RCC understands that the OMC Site is listed on the National Priority List, and that any cleanup program will be a remedial action carried out pursuant to a consent decree under CERCLA § 106.

Therefore, no permits will be required for the "onsite" activities. However, compliance with "applicable or relevant and appropriate" standards must be evaluated. Should enforcement authorities deem certain requirements as "ARAR's" which are unforeseen in RCC's operational plan or scope of work as currently described, additional planning and funding may be required.

RCC expects to obtain a pressure vessel inspection and permit under appropriate Illinois regulations for the high pressure steam boiler (150 psi_g) used to provide steam to the B.E.S.T.TM treatment system.

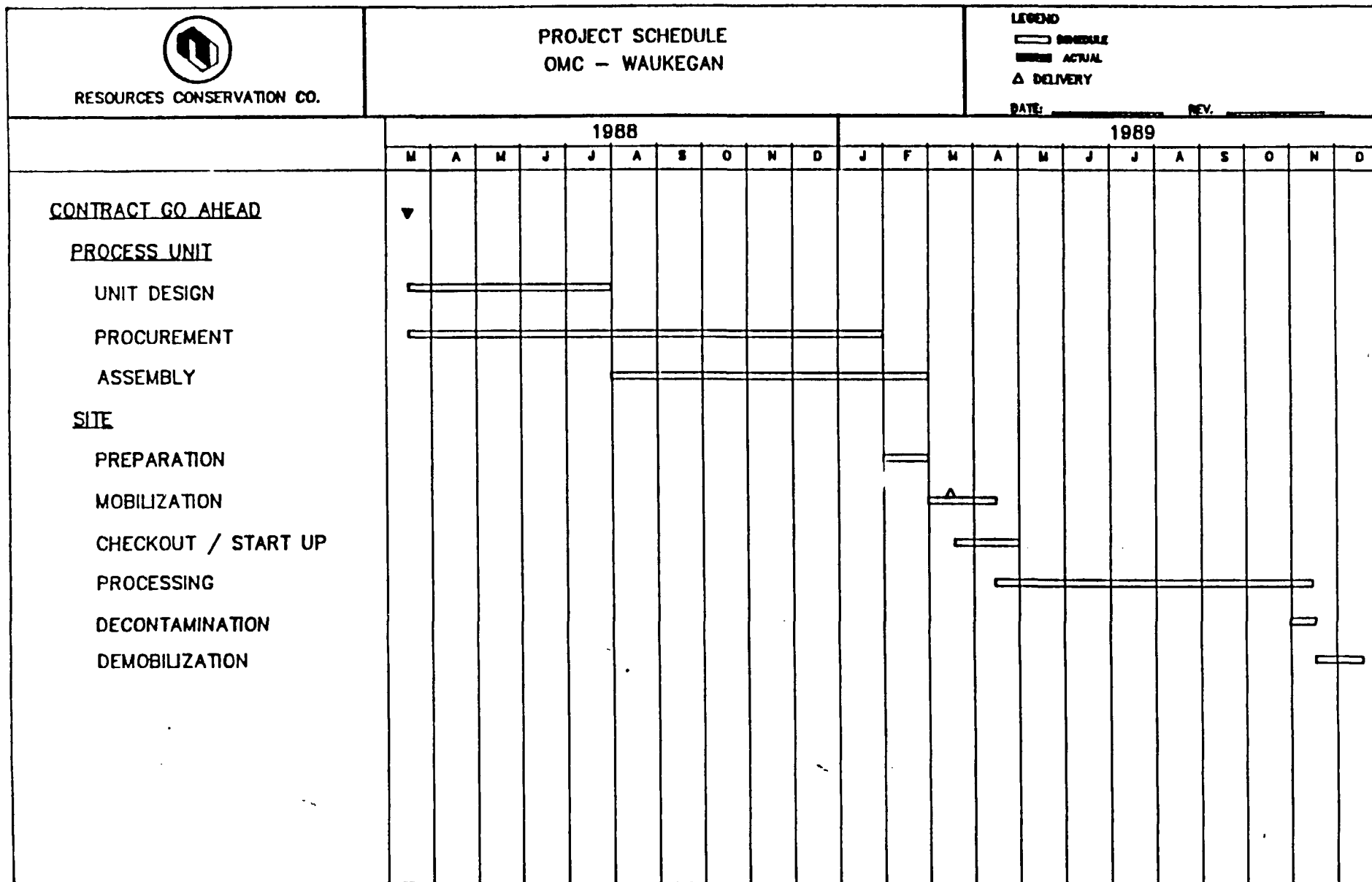


FIGURE 2-3

2.7.2 Off-site Operations

For offsite operations, the following would be required:

Water

On the assumption that the waste impoundments are "TSCA only" wastes, and not restricted "RCRA" wastes, discharges from the system, whether by pipeline to a POTW or by truck or rail transportation, must meet the applicable POTW pretreatment requirements.

Oil

Oil leaving the site will contain the PCB's and will be a TSCA regulated waste. Oil shipments must be made with proper shipping papers (now, just record keeping, no federal hazardous waste manifest required, assuming not a "RCRA" waste) by properly licensed transporter, ultimately to a TSCA licensed PCB disposal facility.

PCB Contaminated Articles

Miscellaneous protective clothing and other articles which cannot be decontaminated must be accumulated as "PCB Contaminated Articles" for shipment to a TSCA licensed PCB disposal facility.

Decontamination Waste Solvents

The final solvent wastes accumulated after triple rinsing of PCB contaminated process equipment, and after steam and/or solvent cleaning of other surfaces exposed to PCB's must be accumulated and shipped to a TSCA licensed PCB disposal facility.

RECEIVED
MAY 16 1987
OMC ENVIRONMENTAL
CONTROL DEPT.

A subsidiary of Reading & Bates Corporation

As you requested, I am enclosing a technical paper prepared by Mark Tose of RCC dealing with removal of PCB's from sludges and sediments with B.E.S.T. Extraction Technology. The paper reports the latest results of laboratory testing conducted to evaluate the effectiveness of the B.E.S.T. process for extracting PCB's from a wide range of sludges and soils. The testing demonstrates that the concentration of residual PCB's in solids is a function of the number of extraction steps. Typical two stage extraction efficiency of PCB's from sludge exceeds 99%. The paper concludes that full scale processing and laboratory testing demonstrates that the B.E.S.T. process is suitable for cleanup of PCB contaminated environmental samples, especially those that contain appreciable amounts of water. Typical PCB extraction efficiencies range from 98% to 99.9%. The PCB's are concentrated in the recovered oil phase. Treated solids are suitable for direct deposition in the environment. The water from the B.E.S.T. process, if necessary, may be treated to remove oil and grease and metals and direct discharged. During a recent discussion, you asked how long it takes to assemble a B.E.S.T. system from the signing of a contract. Our engineers estimate that a unit can be assembled in approximately 9 months, depending on the time required to obtain delivery of the long lead items such as the centrifuges. Also, we estimate that the time required to develop the data required to negotiate a contract is 6 to 8 weeks. This includes laboratory testing and site evaluation.

Dear Mr. Crawford:

Mr. J. Roger Crawford
Outboard Marine Corporation
100 Sea-Horse Drive
Waukegan, IL 60085

November 13, 1987

COPY



RESOURCES CONSERVATION CO.

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(301) 596-6066

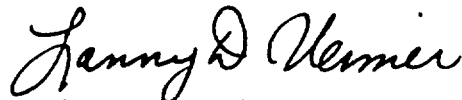
In the letter I sent you on July 1, 1987, I stated that the cost of processing the estimated 48,000 cubic yards of contaminated sediments would be about \$150 per ton. Normally this processing cost estimate is reduced as more information about the application becomes known such as:

- o Required composition of the treated solids - this impacts the number of extraction stages
- o Water treatment requirements for the B.E.S.T. treated water
- o Solvent to solids ratio required to obtain the required oil/water separation
- o Utility costs and availability
- o Front-end handling requirements
- o Overall project scope of work

I hope this meets your current needs. If you require any additional information, please call me at (301)596-6066

Sincerely Yours:

RESOURCES CONSERVATION CO.



Lanny D. Weimer
Regional Manager

Canonie Environmental

A20

July 14, 1988

Canonie Environmental Services Corp.
800 Canonie Drive
Porter, Indiana 46350
Phone 219/426-1100
87-126

Mr. Roger J. Crawford
Corporate Director of Environmental Control
Outboard Marine Corporation
100 Seahorse Drive
Waukegan, IL 60085

Transmittal
Full-Scale Test Run
Taciuk Processor

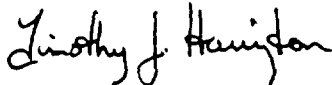
Dear Roger:

We are enclosing two copies of the full-scale test runs completed on the Taciuk processor in Calgary, Canada on April 19 and May 12, 1988. The results indicate that the processor separates the PCBs and oil from the solids with the treated soils showing less than 0.1 ppm polychlorinated biphenyls (PCBs). The results also indicate that no dioxins were generated as a result of processing and that some dibenzofurans present in the PCBs used for the test were found along with PCB in the flue gas from the processor.

Canonie Environmental Services Corp. believes that the data indicates no degradation of PCB into dioxin as a result of processing and is confident that a full-scale transportable unit will have as good or better performance than measured in the full-scale demonstration. Based on the success of the full-scale demonstration, Soiltech, Inc. a 50/50 joint venture between Canonie and UMATAC is going forward with the construction of a transportable Taciuk processor for application to PCBs and other oil residue remediation.

I trust that you will share our views of the test results and that we may have the opportunity to further discuss the use of the Soiltech Taciuk Processor for the OMC project. If you have any questions on the report, please call Mr. Peter Romzick or me.

Very truly yours,



Timothy J. Harrington
Vice President - Midwest

TJH/pr

Enclosures

RECEIVED
JUL 14 1988
OMC ENVIRONMENTAL
CONTROL DEPT.

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TREATMENT OF SOILS CONTAINING PCBS
RESULTS OF TEST RUNS

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TREATMENT OF SOILS CONTAINING PCBS RESULTS OF TEST RUNS

1.0 INTRODUCTION

Over the last 10 years, the Alberta Oil Sands Technology and Research Authority (AOSTRA) has developed a continuous anaerobic thermal process (ATP) for the recovery of oil from soils. The process was invented by William Taciuk of UMATAC Industrial Processes (UMATAC) in Calgary, Alberta, Canada. Waste treatment application of the process in the United States is available through Soiltech, Inc.

In December, 1987, a series of bench tests were run to evaluate the ability of the Taciuk processor to remove polychlorinated biphenyls (PCBs) from contaminated sand and sludge. The test results indicated PCBs were removed from the solids to below detection limits, with no apparent decomposition of PCBs into polychlorinated dibenzofurans (furans) or polychlorinated dibenzodioxins (dioxins).

The processor technology was evaluated further by conducting full-scale demonstrations of the process in the five-ton-per-hour (TPH) process demonstration unit (PDU) located at the testing facilities of UMATAC in Calgary, Alberta. The tests were conducted on oil sands "spiked" with Aroclor 1242.

Two full-scale process demonstrations were made at the UMATAC testing facility. The oily sand was provided by UMATAC and the PCBs (Aroclor 1242) was provided by the Alberta Waste Management Corporation. The objective of the full-scale test runs was to verify that the processor will extract and recover PCBs from soils without creating furans or dioxins.

This report presents the results of the two full-scale process demonstrations.

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2.0 SUMMARY OF RESULTS

In the two-hour test (Test 1) and four-hour test (Test 2) runs, PCBs were stripped from feed soils with initial concentrations of 0.7 and 1.5 percent PCBs by weight (Aroclor 1242) to non-detectable levels [detection limit of 0.1 parts per million (ppm)]. The treated soil concentration was confirmed by independent analyses from two laboratories.

Low levels of PCBs were detected in the processor flue gas. The flue gas stream is the primary emissions source from the process. After Test 1, it was theorized that the PCBs in the flue gas may be originating from leaks between the preheat and the combustion zones of the PDU. Repair work on the leaks was conducted after Test 1 and succeeded in reducing the PCBs to the flue gas train by 86 percent.

The addition of a wet scrubber to the discharge end of the flue gas processing train for Test 2 increased the flue gas cleaning efficiency by a factor of four. The commercial unit will include a more effective wet scrubber and a gas phase activated carbon adsorption system in the flue gas processing train to eliminate the flue gas contaminants.

The results of the test runs indicate that the PCBs do not decompose to furans and dioxins. EPA Modified Method 5 (MM5) sampling trains were used to sample the flue gas for furans and dioxins. Furans were detected in the flue gas but were found to have originated from furans in the PCB feed oil. Dioxins were not detected in the flue gas or PCB feed oil.

A health and safety and air monitoring program was prepared and implemented during the pilot test runs. The plant operators were trained in the use of Level C safety equipment and air monitoring devices were placed at various locations around the process equipment. The monitoring results ranged from non-detectable to 14 micrograms per cubic meter PCB. The highest concentration was approximately two orders of magnitude below the allowable limit for employee exposure.

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3.0 PILOT PLANT RUNS

The full-scale test runs were made in the five TPH PDU located at UMATAC's testing facility in Calgary, Alberta. Test 1 was a 2-hour run during which 126 pounds of PCB oil was fed to the processor. Processor products were collected for a period of 2.5 hours during Test 1. Test 2 was a 4-hour run during which 469 pounds of PCB oil was fed to the processor. Processor products were collected for a period of 4.5 hours during Test 2. The processor systems were operated in much the same fashion as normally used for oil sands or oil shale operations.

3.1 Test Objectives

The objective of the full-scale test runs was to demonstrate the ability of the Taciuk process to remove PCBs from feed soils without creating furans and dioxins.

3.2 Description of PDU

Figure 1 is a schematic diagram of the PDU used for the full-scale test runs. The PDU has a nominal capacity of three to five TPH, depending on the characteristics of the feed material. Commercial units will operate between 5 and 20 TPH.

The thermal processing unit resembles a rotating kiln. It contains four separate internal sections; pre-heat, retort, combustion, and cooling. The feed enters through the pre-heat section, passes through a seal to the retort section, passes through another seal to the combustion chamber, and is cooled by thermal conduction prior to discharge. The pre-heat section operates at a temperature sufficient to vaporize relatively low boiling point materials such as water and light oils. The retort section operates at a temperature sufficient to vaporize heavy oil and PCBs. The seals at both ends of the retort section maintain a near oxygen-free environment and prevent the oxidation of the hydrocarbons at the elevated temperatures in

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the retort section. The combustion section is fired with natural gas to meet the heat requirements for the thermal processing unit. Depending on the feed material, residual carbon (coke) on the soils leaving the retort section is a source of heat input. If the amount of coke is high enough, the heat requirements through the process can be totally provided by burning coke. A portion of the hot sand in the combustion zone is recycled back through the retort section via a sealed passageway. The remaining soils in the combustion section are lifted and distributed onto the exterior of the pre-heat section to provide conductive heat transfer. The heat transfer removes heat from the discharging soils and provides heat to the incoming soils.

3.2.1 Feed Systems and Feed Preparation

The PDU is fed through a series of bins equipped with weigh feeders. These bins deposit sand onto a conveyor belt which transports the feed to the pre-heat section of the kiln. Oversize material is removed by an internal screening system located in the pre-heat section of the kiln.

Pumpable sludges and other liquids can be added directly to the pre-heat zone of the kiln or sludges and sand can be mixed prior to adding the material to the preheat section of the PDU, provided the mixture does not become sticky and difficult to feed through the weigh feeder system. PCBs were pumped directly to the pre-heat zone during the full-scale test runs.

3.2.2 Product Collection Systems

The PDU product collection points are identified on Figure 1. The primary products include sand discharge, oils, water, and flue gas which, following scrubbing, is discharged to the atmosphere.

3.2.3 Pre-heat Water Collection Systems

The low temperature steam and any light oil products from the pre-heat section of the PDU are normally condensed in a cooling tower equipped with

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disk and donut packing. Cooling water is flushed counter-current to the incoming gas stream. The resulting water and light oil product is separated in an oil and water separation tank. Light oil can be skimmed from this tank and stored separately or blended with the primary oil product. The water is stored and sampled prior to disposal. Non-condensable gases from the cooling tower pass through a knock-out drum to remove any residual moisture before venting to atmosphere. During the full-scale test runs, the pre-heat vapor stream was sent to the oil recovery system to minimize the number of discharge streams from the processor.

3.2.4 Oil Recovery System

The vapor stream from the reaction zone passes through two stages of hot cyclones to remove entrained dust and fines. The cyclones remove fine dust prior to condensing the PCBs, oil, and other condensable products. The heavier oil vapors are then condensed in a fractionating tower. Following the fractionating tower, light oils and water are condensed in the overhead condenser and separated in an oil/water separator. The non-condensable gases are sent to a flaring stack.

Side draw and bottoms oils collected in the middle and bottom portions of the fractionation tower are collected and stored.

The light oil product condensed in the overhead condenser is collected and pumped to storage. The majority of the side draw oil and a portion of the overhead oil is used to flush the fractionating tower at the end of a run and dilute the bottoms oil to maintain pumpability at ambient temperature. Water product obtained from the overhead condensor is stored.

3.2.5 Tailings Handling System

All tailings exiting the cooling zone are cooled by water addition then transported to an outside storage pile via screw and belt conveyors.

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3.2.6 Flue Gas Handling and Cleaning System

Coke formed on the solids from the reaction zone is partly or totally combusted to provide the heat requirements of the process. Additional heat requirements, if any, are supplied by natural gas. Additional heat was required for both test runs.

The flue gas from the combustion chamber passes through a single-stage hot cyclone to remove entrained dust. Diluting air and/or water quenching is used to cool the flue gas stream prior to the baghouse which removes the very fine dust not removed by the hot cyclone. During Test 2, the flue gas stream passed through a wet scrubber prior to venting to the atmosphere. The wet scrubber was not utilized during Test 1.

3.3 Test Procedure

Each test was preceded by a "warm-up" period during which the kiln and vapor recovery system were brought up to operating temperature by processing oil sand only. During each test, PCB oil was pumped directly into the pre-heat section of the processor where it mixed with the incoming oil sand.

A summary of the general feed assays and retort and combustion zone operating temperatures are found in Table 1.

Immediately after the PCB addition period, sufficient oil sands were fed to purge out the remaining PCB feed soils. At the end of each test run, the liquid product inventories were sampled. Some PCB feed soil material was held up in the pre-heat section of the reactor as "wall cake". This material was sampled at the end of Test 1 and contained 17,700 ppm PCB at the cool end and 27 ppm PCB at the hot end of the pre-heat zone. The wall cake was not included in the overall material balance for PCBs for Test 1 due to the unknown quantity of wall cake.

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The PCB holdup in the oil recovery system was accounted for, to the degree measurable, at the start of Test 2. The PCB holdup in the system at the start of Test 2 is listed in Table 3 and consists of overhead oil, sour water, sidedraw oil, bottoms oil, and wall cake. The PCBs in the wall cake were not quantifiable, however, PCBs from the wall cake may have been transferred to the liquid holdup during the Test 2 warm up period.

The effect of PCB holdup in the process equipment is less significant with longer operating periods. The duration of the full-scale test runs were limited by PCB material availability and Canadian government regulations. Test 1 consisted of a 2-hour PCB feed period and a 2.5-hour product collection period. Test 2 consisted of a 4-hour PCB feed period and a 4.5-hour product collection period.

During Test 2, the time between the baghouse cleaning cycles was increased to improve the efficiency of the baghouse.

3.4 Test Results

The measurements made during the test runs are presented in raw data form in Appendix A.

3.4.1 PCB Material Balance

A material balance indicating the partition of PCBs among the process products is presented in Tables 2 and 3. In the 2-hour run (Test 1), the PCB feed soil concentration averaged 0.7 percent PCB by weight. In the 4-hour run (Test 2), the PCB feed soil concentration averaged 1.5 percent PCB by weight. In both test runs, the PCB in the treated soil was reduced to less than 0.1 ppm PCB.

During Test 1, 94.5 percent by weight of the feed PCBs were accounted for in the products. During Test 2, 93.2 percent by weight of the PCBs were accounted for in the products. These balances are reasonable considering

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the size of the processing equipment relative to the duration of each test.

In both tests, more than 99.5 percent of the recovered PCBs were in the recondensed hydrocarbon liquids from the fractionating tower (bottoms oil, sidedraw oil, and overhead oil). The PCBs were more highly concentrated in the heavier hydrocarbon fractions.

3.4.2 PCB in the Flue Gas

Some PCBs were detected in the flue gas during both test runs, see Table 4. During Test 1, the flue gas was sent through a cyclone and baghouse only. During Test 2, the flue gas was sent through a cyclone, bag house, and a wet scrubber. The flue gas was sampled during both tests using the EPA Modified Method 5 (MM5) sampling train. Because of the modification in flue gas processing equipment, the flue gas sampling location was not identical for both test runs.

The flue gas cleaning system removed 17 and 63 percent by weight of the PCBs in the flue gas stream for Tests 1 and 2, respectively, see Tables 2 and 3. The quantity of PCBs released with the cleaned flue gas stream was 0.31 and 0.02 percent by weight of the PCB feed for Tests 1 and 2, respectively.

During commercial operation, the fines recovered by the flue gas cleaning system will be reprocessed as required to reduce the PCBs in an acceptable level.

The source of the PCBs in the flue gas results from internal leaks in the processor between the pre-heat zone and the downstream portion of the combustion zone. The PDU is heavily instrumented with thermocouples which provide conduits between the zones. Between Test 1 and Test 2 an attempt was made to seal leaks through loose or empty thermocouple holes in the shell separating the pre-heat zone and the combustion zone. During Test 2, the total quantity of PCBs entering the flue gas processing train was

TABLE 4

reduced by a factor of two despite a four-fold increase in the total PCB quantity fed to the processor:

	<u>Total PCBs in Feed Soils Pounds</u>	<u>Total PCBs Entering Flue Gas Processing Train Pounds</u>	<u>Total PCBs in Processed Flue Gas Stream Pounds</u>
Test 1	117.5	0.42	0.36
Test 2	440.6	0.24	0.09

In Test 2, the combination of the leak repairs and the addition of the wet scrubber to the gas cleaning train significantly reduced the PCBs released in the processed flue gas:

	<u>Grams of PCBs in Untreated Flue Gas Per Kilogram of PCB in Feed</u>	<u>Grams of PCBs in Processed Flue gas Per Kilogram of PCB in Feed</u>	<u>Flue Gas Cleaning Efficiency</u>
Test 1 (no wet scrubber)	3.6	3.1	14 Percent
Test 2 (wet scrubber used)	0.5	0.2	60 Percent

The leakage between the pre-heat and combustion zone will be eliminated in the new processor constructed for field remediation work. As a safeguard measure, the new processor will employ a flue gas cleaning train consisting of a cyclone, baghouse, wet scrubber, and gas phase activated carbon designed to effectively clean the flue gas to levels less than 0.001 gram PCB in exiting flue gas per kilogram of PCB in the feed. The new processor will include additional improvements, such as larger reaction and combustion zones, approximately 50 and 30 percent larger in relative terms, to increase time and reduce particulate entrainment.

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3.4.3 PCB Contamination in Flare Gas

An XAD gas trap was installed by Chemex Labs Alberta, Inc. (Chemex) on the flare gas line. The analytical results of the gas sample are presented in Appendix B.

Chemex was not able to detect PCBs in the flare gas.

3.4.4 Furans and Dioxins

During Test 1, furans were detected in the exiting flue gas stream, see Table 5. No dioxins were detected in the flue gas stream. No other streams were analyzed for furans or dioxins.

Based on the furans detected during Test 1, the Test 2 PCB oil feed was evaluated as a potential source for furans. During Test 2, furans were detected in the flue gas and PCB oil feed. The presence of furans has been documented as an impurity in commercial mixtures of PCBs (Erickson, Mithcell D., Analytical Chemistry of PCBs, Butterworth Publishers, Stoneham, MA, 1986). The flue gas contained 14 percent by weight of the tetrachlorodibenzofurans detected in the PCB feed oil. Dioxins were not detected in any of the samples analyzed.

Based on the absence of dioxins in the flue gas, the furans in the flue gas are from the furans in the PCB feed oil only. As mentioned earlier, a gas phase activated carbon absorption system will be used in the flue gas processing train during commercial operations.

3.4.5 Flue Gas and Flare Gas Composition

The compositions of the flue gas and the flare gas were measured continuously during the pilot operation. The results of these measurements are presented in Appendix C.

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In commercial units, the flare gas will be injected into a small pre-combustion chamber where the gases will be burned. The gases exiting the pre-combustion chamber will then flow into the processor combustion zone.

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4.0 HEALTH AND SAFETY MONITORING

Prior to conducting the test runs, all employees working at the site were provided with Health and Safety training. This training included the health hazards associated with PCBs and its decomposition products, the physical properties of the chemicals, and the proper usage of a variety of personal protective equipment (including respiratory protection and protective clothing). Qualitative "fit" testing of the half-mask respirators was conducted using amyl acetate. The training also included demonstrations of the effective method for donning and doffing a personal protective equipment ensemble comparable to Level C. Personal habits and the effect on chemical absorption were emphasized. These habits included personal hygiene, when and where it would be acceptable to eat, drink, and smoke, and the correct procedure to follow to doff the protective equipment without contaminating other areas.

As part of the evaluation of potential exposure to employees to PCBs, air monitoring was conducted before the Test 1 to establish background levels at various points surrounding the pilot plant. The locations of the monitoring equipment were also used to evaluate concentrations during the test runs. During the test runs, the employees utilized the following personal protective equipment as appropriate for their assigned job duties.

- o Scott half-mask respirator with organic vapor cartridges.
- o Polyethylene coated Tyveks or polypropylene disposable coveralls with boot coverings.
- o Polyvinyl Latex inner gloves.
- o Polyvinylchloride outer gloves.
- o Safety glasses.

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- o Hard hat with face shield.
- o Safety boots.

4.1 Air Monitoring

The background and potential exposure monitoring were conducted as area samples at four locations. The equipment locations were:

1. Outside plant - 50 feet from baghouse;
2. Condenser side of kiln;
3. Conveyor side of kiln;
4. Center of plant floor - five feet high.

The purpose of this monitoring was to determine if PCB vapors and/or particulates were being emitted into the plant during operation and resulting in a significant potential exposure to employees working in the area.

The sampling and analytical method used was National Institute of Occupational Safety and Health Method Number 5503. In this method, the collection media specified is florasil tubes with backup section and a 13mm glass fiber prefilter. The pumps used were Gilian models which calibrated before and after the monitoring period to a flow rate of approximately 0.2 liter/minute. The collection period varied with the test run. The background samples and the Test 1 run samples collected material for a full-shift duration (8-10 hours). The collection period for Test 2 was reduced closer to the actual test time period, which was approximately 5.5 hours.

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The analytical method used by an American Industrial Hygiene Association certified laboratory (Clayton) was gas chromatography with an electron capture detector. The analytical results are presented in Appendix D and Summarized in Table 6.

In general, the monitoring results indicated non-detectable levels of PCBs collected during the background sampling. The laboratory detection limit is reported as 0.06 micrograms for the vapor constituent and 0.05 micrograms for the particulate constituent. The monitoring results obtained during Test 1 were reported as non-detectable with the same limits of detection. The monitoring results obtained during Test 2 ranged from non-detectable to 14 micrograms per cubic meter for the 5.5-hour monitoring period with the same detection limits. An allowable exposure level for Aroclor 1242, which was the test material, has been set by the Occupational Safety and Health Administration. This allowable exposure is 1,000 micrograms per cubic meter for an 8-hour exposure period. The Canadian Department of Health has established the same allowable exposure limit.

The highest concentration reported for which there is a potential employee exposure was at least two orders of magnitude below the allowable limit.

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5.0 SAMPLING AND ANALYTICAL QUALITY ASSURANCE/QUALITY CONTROL

To verify the accuracy of the test results, samples of the feeds and products for Test 2 were analyzed by two laboratories. The samples were analyzed by Chemex in Calgary, Alberta, Canada, and Clayton Environmental Consultants, Inc. (Clayton) in Novi, Michigan, United States of America. Many of the samples were not true duplicates but composites of samples taken throughout the run.

5.1 Samples Taken

A list of samples taken during Tests 1 and 2 is presented in Appendix B. Chain-of-custody records for these samples are presented in Appendix E. The sample points are identified on Figure 1.

5.2 Comparison of Analytical Results

Analytical results on the samples provided to Chemex and Clayton are presented in Appendix B. In some cases the results reported by the laboratories varied significantly. In the material balances shown in Tables 2 and 3, the Chemex analyses were used to evaluate the partition of the PCBs in both liquid and solid feed and products. The Clayton analyses of the MM5 gas train samples were used to determine air emissions, since this laboratory is EPA certified and is capable of quantifying the furans and dioxins.

5.2.1 Material Balance Check Analyses

At the end of Test 2, composites of the samples taken during the test were assembled to check the PCB values being used in the material balance calculations. These samples were assayed by Clayton and are summarized in Table 7.

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Clayton confirmed that the PCB levels in the tailings were below detection limits. A major discrepancy affecting the material balance is the low PCB concentration measured by Clayton in the PCB feed oil. Clayton has suggested this discrepancy could be caused by the unusually high PCB content of the feed. The Chemex assays for PCB content of the feed were used for the material balance since more PCB was collected in the products than the Clayton assay indicates was in the feed.

5.2.2 Comparison of PCB/Furan/Dioxin Gas Train Results

The results of furan/dioxin analysis of gas train samples analyzed by Chemex and Clayton are presented in Appendix B. The results of the Clayton analyses are summarized in Tables 4 and 5.

Clayton has the capacity to quantify the furans and dioxins in the flue gas. Chemex does not have the capability to quantify furans and dioxins. The Clayton analyses for PCBs, furans, and dioxins were used in the material balances and process analyses.

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6.0 CONCLUSIONS

The results from the four-hour test run (Test 2) show that:

1. The processor does not generate dioxins as a result of the anaerobic processing;
2. The treated soils contain no PCBs at a detection limit of 0.1 ppm;
3. The air treatment equipment on the flue gas discharge reduces particulate PCB emissions by 63 percent.

The test results indicate that the Taciuk processor will separate PCBs from soil or sediment. The construction of a transportable Taciuk processor will include additional flue gas treatment with vapor phase carbon to eliminate the flue gas contaminants.

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TABLES

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TABLE 1
FEED ASSAYS
RETORT AND COMBUSTION ZONE TEMPERATURES

<u>Test No.</u>	<u>Component</u>	<u>Assay, %</u>	<u>Feed Rate Tons Per Hour</u>	<u>Retort Zone</u>	<u>Temperature Conditions</u>		
					<u>Temp. F</u>	<u>Combustion Zone</u>	<u>Temp. F</u>
1	PCB	0.7	4.2	Entrance	1,010	Entrance	1,165
	Oil	2.4		Mid Zone	1,025	Mid Zone	1,185
	Water	2.7		Exit	1,040		
	Solids	94.2		Vapor	1,050		
2	PCB	1.5	3.7	Entrance	1,044	Entrance	1,207
	Oil	2.8		Mid Zone	1,057	Exit	1,269
	Water	1.9		Exit	1,064		
	Solids	93.8		Vapor	1,070		

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TABLE 2
PCB MATERIAL BALANCE FOR 2-HOUR TEST¹
(FULL-SCALE TEST NO. 1)

<u>Description</u>	<u>Weight, LBS.</u>	<u>PCB, PPM</u>	<u>PCB, LBS</u>	<u>Dist., %</u>
Feed:				
PCB Oil	126	935,000	117.53	100.0
Solid Products:				
Product Sand	19,097	<0.1	0.00	0.0
Baghouse Dust	266	195	0.05	0.0
Kiln End Leakage	279	<0.1	0.00	0.0
Flue Gas Cyclone	358	30	0.01	0.0
Hydrocarbon Cyclone	90	<0.1	0.00	0.0
Liquid Products:				
Overhead Oil	1,725	9,830	16.95	14.4
Sour Water	1,551	5	0.01	0.0
Side Draw Oil	48	19,870	0.95	0.8
Bottoms Oil	1,417	65,431	92.73	78.9
Preheat Seal Condensate	2	2	0.00	0.0
Flare Liquids	30		0.00	0.0
Gas Products:		MG/M3		
Flare Gas	143		0.00	0.0
Flue Gas	7,030	69	0.36	0.3
TOTAL PCB IN			117.53	
TOTAL PCB OUT			111.06	
ACCOUNTABILITY, %			94.50%	

¹ PCBs were fed to the processor over a 2-hour period and products were recovered over a 2.5-hour period. Average total feed rate of soil and PCBs was 8,416 lbs/hr.

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TABLE 3
PCB MATERIAL BALANCE FOR 4-HOUR TEST¹
(FULL-SCALE TEST NO. 2)

<u>Description</u>	<u>Weight, LBS</u>	<u>PCB, PPM</u>	<u>PCB, LBS</u>	<u>Dist., %</u>
Feed:				
PCB Oil	469	939,000	440.58	92.4
Starting Inventory:				
Overhead Oil	2,557	8,680	22.19	4.7
Sour Water	294	8	0.00	0.0
Side Draw Oil	117	10,600	1.24	0.3
Bottoms Oil	777	16,200	12.59	2.6
Wall Cake	Unknown	27-17,700		
Solid Products:				
Product Sand	30,195	<0.1	0.00	0.0
Baghouse Dust	238	240	0.06	0.0
Kiln End Leakage	471	<0.1	0.00	0.0
Flue Gas Cyclone	658	12	0.01	0.0
Hydrocarbon Cyclone	210	1	0.00	0.0
Liquid Products:				
Overhead Oil	1,639	24,600	40.31	8.5
Sour Water	2,414	24	0.06	0.0
Side Draw Oil	48	19,870	0.95	0.2
Bottoms Oil	2,552	157,725	402.48	84.4
Preheat Seal Condensate	4	738	0.00	0.0
Scrubber Water	4,880	13	0.08	0.0
Flare Liquids	61		0.00	0.0
Gas Products:		MG/M3		
Flare Gas	263		0.00	0.0
Flue Gas	13,770	9	0.09	0.0
TOTAL PCB IN			476.60	
TOTAL PCB OUT			444.04	
ACCOUNTABILITY, %			93.17%	

¹ PCBs were fed to the processor over a 4-hour period and products were recovered over a 4.5-hour period. Average total feed rate of soil and PCBs was 7,374 lbs/hr.

TRADE SECRET

TABLE 4
PCBS IN FLUE GAS AND OIL FEED

<u>Test No.</u>	<u>PCB Concentration in Flue₃ Gas ug/m³</u>	<u>Total Mass PCB in Flue Gas, gm</u>	<u>Total Mass PCB in Oil Feed, Kg</u>
1	68,600	195	53.6
2	8,630	48	200.0

Notes:

¹Flue gas stream sampled using EPA Modified Method 5 sampling train.

²Values based on analysis by Clayton Environmental Consultants, Inc., see Appendix C for raw analytical data.

TRADE SECRET

TABLE 5
FURANS AND DIOXINS IN FLUE GAS AND OIL FEED

<u>Test No.</u>	<u>Compound</u>	<u>Concentration In Flue Gas, ng/m³</u>	<u>Total Mass In Flue Gas, mg</u>	<u>Total Mass in Feed, mg</u>
1	2,3,7,8 Tetra- chlorodibenzofuran	13	0.037	NA
	Total Tetra- chlorodibenzofurans	126	0.36	NA
	2,3,7,8 Tetra- chlorodibenzo-p- dioxin	<11	-	NA
2	2,3,7,8 Tetra- chlorodibenzofuran	75	0.42	20.2
	Total Tetra- chlorodibenzofurans	1,934	10.8	78.8
	2,3,7,8 Tetra- chlorodibenzo-p- dioxin	<29	-	-

Notes:

¹NA - Not Analyzed

²Values based on analysis by Clayton Environmental Consultants, Inc., see Appendix C for raw analytical data.

TRADE SECRET

TABLE 6
SUMMARY OF PCB MONITORING RESULTS
FOR AROCLOR 1242

BACKGROUND MONITORING

<u>Date</u>	<u>Sample Location</u>	<u>Volume (L)</u>	<u>Florisil ng</u>	<u>Filter ng</u>	<u>Total ng/m3</u>
4/18/88	Center of Plant Floor Five Feet High	152	ND	ND	ND
4/18/88	Conveyor Side of Kiln	172	ND	ND	ND
4/18/88	Condenser Side of Kiln	170	ND	ND	ND
4/18/88	Outside Plant	148	ND	ND	ND

FIRST PILOT RUN

<u>Date</u>	<u>Sample Location</u>	<u>Volume (L)</u>	<u>Florisil ng</u>	<u>Filter ng</u>	<u>Total ng/m3</u>
4/19/88	Center of Plant Floor Five Feet High	93	ND	ND	ND
4/19/88	Conveyor Side of Kiln	93	ND	ND	ND
4/19/88	Condenser Side of Kiln	102	ND	ND	ND
4/19/88	Outside Plant	93	ND	ND	ND

SECOND PILOT RUN

<u>Date</u>	<u>Sample Location</u>	<u>Volume (L)</u>	<u>Florisil ng</u>	<u>Filter ng</u>	<u>Total ng/m3</u>
5/12/88	Center of Plant Floor Five Feet High	52	0.21	0.09	5.8
5/12/88	Condenser Side of Kiln	50	0.26	0.14	8.0
5/12/88	Conveyor Side of Kiln	56	0.68	0.09	14.0
5/12/88	Outside Plant	56	<0.07	<0.07	ND

ND - Not Detected

TRADE SECRET

TABLE 7
SUMMARY OF CHEMEX AND CLAYTON PCB ASSAYS, TEST 2

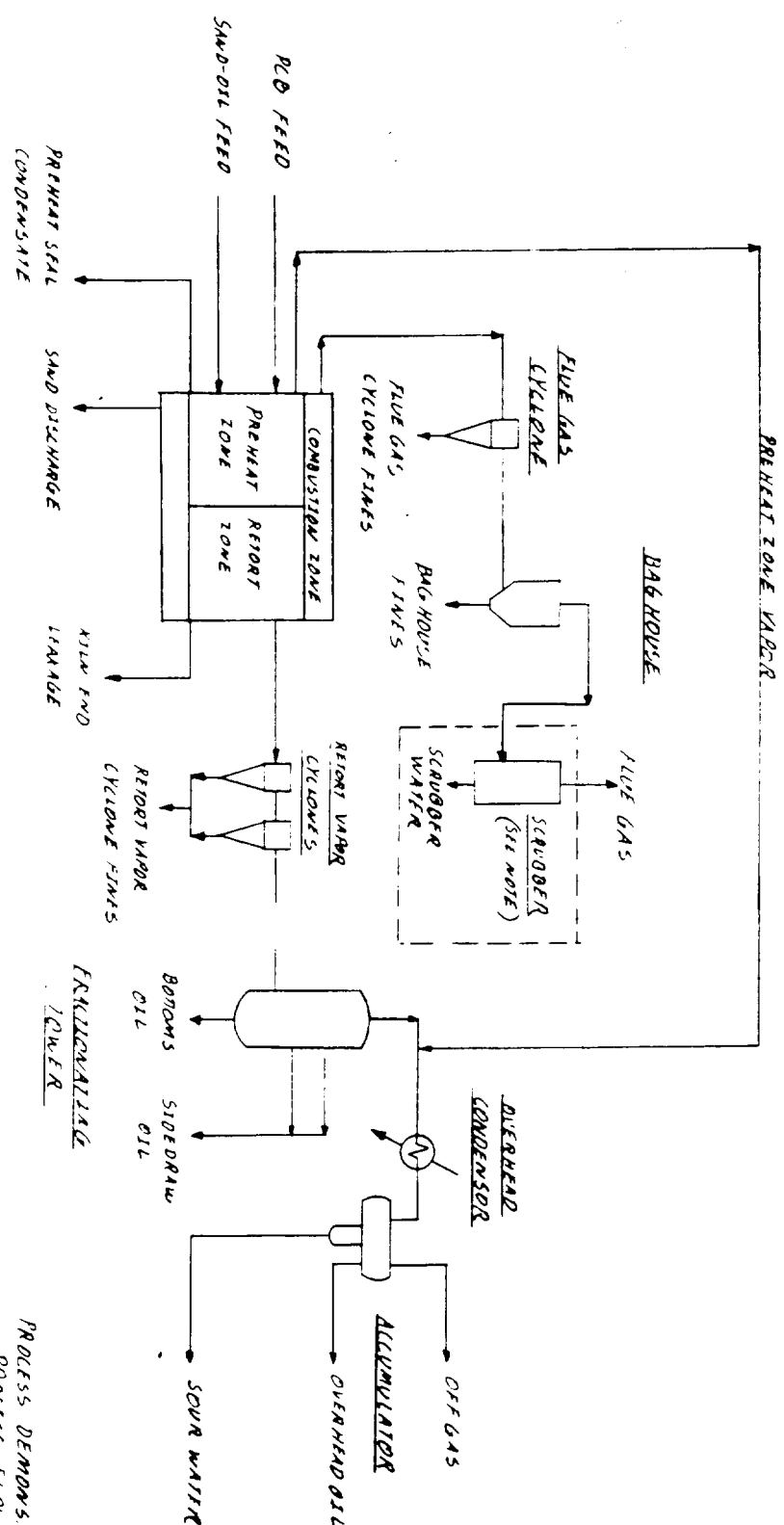
<u>Sample Location</u>	<u>Chemex Assay¹ ppm</u>	<u>Clayton Assay, ppm</u>
Feed:		
PCB Oil Feed Composite	939,000	520,000
Solid Products:		
Kiln End Leakage Composite	<.1	0.3
HC Cyclone Fines Composite	1	<0.3
Flue Gas Cyclone Composite	12	11
Baghouse Fines Composite	240	170
Tailings Discharge Composite	<.1	<0.3
Liquid Products:		
Overhead Oil Composite	24,600	21,000
Bottoms/Sidedraw Oil Composite	155,180	91,000
Sour Water Composite	24	0.033
Scrubber Liquid Composite	13	0.15

¹Chemex Assay values of solids and liquids were used in the material balance calculations for Test 2.

TRADE SECRET

FIGURES

TRADE SECRET



NOTE: THE SCRUBBER WAS USED DURING TEST 2 ONLY

ANAEROBIC THERMAL PROCESSOR

FIGURE 1
PROCESS DEMONSTRATION UNIT (PL
PROCESS FLOW DIAGRAM)

APPENDIX
A

APPENDIX A
RAW DATA

TRADE SECRET

PCB FEED

worksheet PCBWT.WK1 yields 125.7 lbs (PCB + solvent)

	PCB feed % PCB's		
CHEMEX data	15:00	95 %	1
	17:00	92 %	1
			AVG.
			93.5 %

PCB feed (lbs) = 125.7 x 0.935 = 117.53

END INVENTORY

		lbs	CHEMEX PCB conc ppm	CHEMEX PCB conc mf.		lbs
OVERHEAD OILS	ovhd drum	1724.7	9830	0.009830	=	16.95
SOLV P&O	ovhd drum	293.7	13.4	0.000013	=	0.00
	drums	1257.0	3	0.002203	=	0.00
SIDE DRAW	piping	48.0	19870	0.003970	=	0.95
BOTTOMS OIL	bbl #1	442.0	69050	0.069050	=	30.52
	bbl #2	410.0	69700	0.069200	=	28.37
	bbl #3	473.0	65000	0.065000	=	30.91
	filters & piping	92.2	65000	0.065000	=	6.03
TAILINGS SAND	7638.9 lbs/hr 2.5 hours	19097.3	0.1	0.000000	=	0.00
BAGHOUSE	106.4 lbs/hr 2.5 hours	266.0	195	0.000195	=	0.05
KILN END LEAKAGE	111.4 lbs/hr 2.5 hours	278.5	0.1	0.000000	=	0.00
FLY AS CYCLONE	142.1 lbs/hr 2.5 hours	357.8	30	0.000030	=	0.01
PREHEAT SEAL CONDENSATE	2.2	1.9		0.000000	=	0.00
HC CYCLONE	36 lbs/hr 2.5 hours	90.0	0.1	0.000000	=	0.00

OFF GASES	flare liquid lbs/hr	flare gas lbs/hr	total lbs/hr
C4&+	11.7	24.0	35.7
C3&-	0.1	33.0	33.1

in	C4&+ lbs	89.3	1	0.000001	=	0.00
2.5 hours	C3&- lbs	82.8	0.001	0.000000	=	0.00

C3&- estimated by equilibrium at
1/1000 of the liquid concentration

FLUE GASES

2412 lbs/hr @ 30.09 MW
 @ 60 F = 0.070094 lbs/ft³
 volumetric rate = 40117.49 ft³/hr
 CHEMEX @ 0.12 ug/ft³ = 4814.099 ug/hr
 = 0.000010 lbs/hr
 over 2.5 hours 0.00

END INVENTORY - lbs ----> 113.81
 FEED PCB'S ---- lbs ----> 117.58
 CLOSURE ----- % -----> 96.83

UMATAC atmospheric distillation results gave slightly lower PCB values
 in the PCB feed mixture as follows:

Solvents (below 300 deg C B.P.)	2.5ml @ 0.9	S.G. = 2.25 g
PCB's (above 300 deg C B.P.)	17.5ml @ 1.335	S.G. = 23.36 g
		total 25.61 g

23.36/25.61 = 91.2 % PCB's

Using this value, the closure on PCB's would be 96.8 x .935/.912 = 99.27 %

MINERAL BALANCE

RUN DATE

April 19, 1988

WINDOW

28 VERSION 1

REV

1 PAGE 2

STREAM NUMBER	STREAM DESCRIPTION	SOLIDS (lb/hr)	LOI (wt%)	MINERAL (lb/hr)
111	CONV TAILINGS	7689.2	8.2	7593.4 by difference
138	FLUE CYCL DUST	143.1	1.2	141.4
138	BAGHOUSE DUST	266.8	4.3	181.8
189	KILN END LEAK	111.4	8.3	111.1
158	HC CYCL DUST	98.8	4.2	34.5
157	BOTTOM OIL	16.6	7.6	15.3
154	DAYTANK OIL	8.8	8.8	8.8

WATER BALANCE

STREAM NUMBER	STREAM DESCRIPTION	RATE (lb/hr)	(wt % of feed)
183	PREHEAT VENT	8.8	8.8
184	RETORT VAPOUR	388.8	133.4
TOTAL		388.8	133.4

MASS BALANCE CALCULATIONS

RUN DATE

April 19, 1988

WINDOW 12:44 16:16 3.53333 hours

WINDOW

28 VERSION

1

REV

99 PAGE

3

FEED RATE

25.3168 tons in 6.81666 hours

4.28777 tons/hour

8415.55 lbs/hr

FEED QUALITY

AVG.
mass% lbs/hr

	(a)	(b)		
oil	2.5	2.3	2.4	282.8
water	2.8	2.7	2.75	231.4
solids	94.7	95	94.85	7982.2

Bottoms OIL	248 lbs in	3.53333 hours=	67.9 lbs/hr
TIF	24.4 %	solids=	16.6 lbs/hr
clean=	51.4 lbs/hr		

SOLIDS	COLLECT lbs	TIME hours	RATE lbs/hr	LOI %	COKE lbs/hr	SOLIDS lbs/hr
kiln end leak	111.4	1	111.4	8.296	8.3	111.1
MC cyclone	98	2.5	36.8	4.289	1.5	34.5
flue gas cyclone	143.1	1	143.1	1.166	1.7	141.4
baghouse	266	2.5	106.4	4.388	4.6	101.8
bottoms oil	16.5735	1	16.6	7.6	1.3	15.3
						388.8

clean tailing sand=	7982.2	-	388.8	=	7593.4
LOI on tailings (mass%)					8.288
coke on tails =					15.8

C as CO, CO2

	time	Igal	Igal	temp	API	SG
diesel	12:45	3826.8	1	68	41	0.82028
	16:38	3854.2	28.2	68	41	0.82028

time=	3.75 hours
rate=	61.7 lbs/hr

C as CO, CO2 =	53.3
H2 =	8.4

propane (fuel not measured, use previous run ratios)

	diesel	propane
871112v28	43.8	8.6 lbs/hr of C as
871112v38	66.4	8.6 CO and CO2
	55.1	8.6

so use propane C as CO, CO2 as	8.3 lbs/hr
so overall propane rate =	18.2 lbs/hr
and H2 =	1.9 lbs/hr

LOI weight % on oil mix feed solids extracted by Dean&Stark

feed	(a)	(b)	
	1.341	1.278	
	1.223	1.276	AVG= 1.2883 wt %
	1.239	1.373	

C as CO, CO2 or COKE on feed	182.8 lbs/hr
------------------------------	--------------

OILS

overall inventory change yields	188.4 lbs/hr
bottoms oil solids =	16.6 lbs/hr
clean oil product =	91.8 lbs/hr

TACILUK PROCESSOR MASS BALANCE REPORT

RUN DATE April 19, 1988
 WINDOW 38 VERSION 1
 REV 99 PAGE 1

WINDOW 16:23 to 18:23

RUN CONDITIONS

FEED TYPE OIL MIXED WITH SAND + PCB's
 FEED RATE 4.21 tons/hour
 WINDOW LENGTH 2.00
 FEED COMPOSITION (wt%) (lbs/hr)
 .. PCB 0.7 62.4
 OIL 2.4 200.5
 WATER 2.7 229.7
 MINERAL 94.1 7923.0

RETORT TEMPS (F)

ENTRANCE 1010
 MID_ZONE 1025
 EXIT 1040
 VAPOUR 1050

COMBUSTION TEMPERATURES (F)

ENTRANCE 1165
 MID_ZONE 1105
 VAPOR

 100.0 8415.6

OIL RECYCLE NO
 RPM 4.75

HYDROCARBON BALANCE

STREAM #	STREAM DESCRIPTION	C4&+	C3&-	COKE	C as CO&CO2	
101	FEED			-10.3	-92.6	
107	DIESEL FUEL				-49.6	
119	PROPANE FUEL				-7.7	
152	FLARE GAS	24.0	33.0		34.1	
152	FLARE LIQUID	11.7	0.1			
154	DAYTANK OIL	0.0		0.0		
131	FLUE GAS				120.3	
111	CONV TAILINGS			15.0		
130	FLUE CYCL DUST			1.7		
130	BAGHOUSE DUST			4.6		
109	KILN END LEAK			0.3		
150	HC CYCL DUST			1.5		
157	BOTTOM OIL	169.6		3.3		
126	PREHEAT VENT	0.0				

	TOTALS (lb/hr)	205.3	33.1	17.0	12.5	= 267.8
	(% OF PRODUCTS)	76.6	12.4	6.3	4.7	= 100.0
	(% OF FEED)	70.1	12.6	6.4	4.8	= 101.9

MINERAL BALANCE

RUN DATE

April 19, 1968

WINDOW

28 VERSION 1

REV

1 PAGE 2

STREAM NUMBER	STREAM DESCRIPTION	SOLIDS (lb/hr)	LOI (wt%)	MINERAL (lb/hr)
111	CONV TAILINGS	7609.2	0.2	7593.4 by difference
130	FLUE CYCL DUST	143.1	1.2	141.4
130	BAGHOUSE DUST	266.0	4.3	101.8
109	KILN END LEAK	111.4	0.3	111.1
150	HC CYCL DUST	90.0	4.2	34.5
157	BOTTOM OIL	43.5	7.6	40.2
154	DAYTANK OIL	0.0	0.0	0.0

WATER BALANCE

STREAM NUMBER	STREAM DESCRIPTION	RATE (lb/hr)	(wt % of feed)
103	PREHEAT VENT	0.0	0.0
104	RETORT VAPOUR	506.2	220.4
TOTAL		506.2	220.4

MASS BALANCE CALCULATIONS

RUN DATE

April 19, 1988

WINDOW 16:23 18:23

2 hours

WINDOW

38 VERSION

1

REV

99 PAGE

3

FEED RATE

25.3168 tons in 6.81666 hours

4.28777 tons/hour

8415.55 lbs/hr

FEED QUALITY

	(a)	(b)	AVG. mass%	lbs/hr
oil	2.5	2.3	2.4	202.0
water	2.8	2.7	2.75	231.4
solids	94.7	95	94.85	7982.2

PCB's 125.7 lbs in 2 hours = 62.85

PCB	62.9	0.74		8478.40
oil	202.0	2.38		
water	231.4	2.73		
solids	7982.2	94.15		

Bottoms OIL 356.956 lbs in 2 hours = 178.5 lbs/hr
 TIF 24.4 % solids = 43.5 lbs/hr
 clean = 134.9 lbs/hr

SOLIDS	COLLECT lbs	TIME hours	RATE lbs/hr	LOI %	COKE lbs/hr	SOLIDS lbs/hr
kiln end leak	111.4	1	111.4	8.296	0.3	111.1
MC cyclone	90	2.5	36.0	4.209	1.5	34.5
flue gas cyclone	143.1	1	143.1	1.166	1.7	141.4
baghouse	266	2.5	106.4	4.388	4.6	101.8
bottoms oil	43.5486	1	43.5	7.6	3.3	40.2

=====

388.8

clean tailing sand = 7982.2 - 388.8 = 7593.4
 LOI on tailings (mass%) 0.288
 coke on tails = 15.8

C as CO, CO2

	time	lgal	lgal	temp	API	SG
diesel	16:30	3854.2	1	60	41	0.82028
	18:30	3868.2	14	60	41	0.82028

time = 2 hours
 rate = 57.4 lbs/hr

C as CO, CO2 = 49.6
 H2 = 7.8

RUN DATE	April 19, 1988	
WINDOW	38 VERSION	1
REV	99 PAGE	4

propane (fuel not measured, use previous run ratios)

	diesel	propane	
871112v28	43.8	8.6 lbs/hr of C as	
871112v38	66.4	8.6 CO and CO2	
	55.1	8.6	

so use propane C as CO, CO2 as	7.7 lbs/hr
so overall propane rate =	9.5 lbs/hr
and H2 =	1.7 lbs/hr

feed	LOI weight % on oil mix feed solids extracted by Dean&Stark		
	(a)	(b)	
	1.341	1.278	
	1.223	1.276	AVG= 1.28833 wt %
	1.239	1.373	

C as CO, CO2 or COKE on feed	182.8 lbs/hr
------------------------------	--------------

OILS	overall inventory change yields	213.1 lbs/hr
	bottoms oil solids =	43.5 lbs/hr
	clean oil product =	169.6 lbs/hr

PCB FEED

PRELIMINARY BALANCE
Jun 9

worksheet PCBWT.WK1 yields 469.2 lbs (PCB + solvent)

	PCB feed % PCB's		
CHEMEX data	15:00	95 %	
	17:00	92 %	
	RUN #2	94.84 %	
			sd= 1.37
			AVG. 93.9 %

PCB feed (lbs) = 469.2 x 0.9394656667 = 440.88

		lbs	CHEMEX PCB conc ppm	CHEMEX PCB conc mf		
--	--	-----	------------------------------	-----------------------------	--	--

STARTING INVENTORY

OVERHEAD OILS	ovhd drum	2556.6	8680	0.008680	=	22.19
SOUR H2O	ovhd drum	293.7	8.48	0.000008	=	0.00
SIDE DRAW	oil level	99.9	10600	0.010600	=	1.06
	piping	16.9	10600	0.010600	=	1.81
BOTTOMS OIL	oil level	596.9	16200	0.016200	=	9.67
	piping	180.2	16200	0.016200	=	2.92

END INVENTORY

OVERHEAD OILS	ovhd drum	1638.6	24600	0.024600	=	40.31
SOUR H2O	ovhd drum	293.7	7.64	0.000008	=	0.00
	drums	2120.0	26.5	0.000027	=	0.06
SIDE DRAW	piping	48.0	19870	0.019870	=	0.95
BOTTOMS OIL	bbl#1	488.0	142400	0.142400	=	69.49
	bbl#2	282.0	156900	0.156900	=	44.72
	bbl#3	358.0	201800	0.201800	=	72.11
	bbl#4	373.0	184300	0.184300	=	68.74
	bbl#5	392.0	134400	0.134400	=	52.68
	bbl#6	452.0	127100	0.127100	=	57.45
	bbl#7	55.0	127100	0.127100	=	6.99
	filters & piping	151.8	201800	0.201800	=	30.63

TAILINGS SAND	6710 lbs/hr	255.8	157,725			402.4
	4.5 hours					
	30195.0		0.1	0.000000	=	0.00302

BAGHOUSE	52.8 lbs/hr					
	4.5 hours					
	237.6		240	0.000240	=	0.06

KILN END LEAKAGE 104.7 lbs/hr

PCB BALANCE

PCBBAL.WK1

PRINT DATE: 03-Jun

TRADE SECRET

	4.5 hours					
	471.2	0.1	0.000000	-		0.00
FLUE GAS CYCLONE	146.2 lbs/hr					
	4.5 hours					
	657.9	11.7	0.000012	-		0.01
PREHEAT SEAL CONDENSATE	4.0	738	0.000738	-		0.00
HC CYCLONE	46.6 lbs/hr					
	4.5 hours					
	209.7	1	0.000001	-		0.00
SCRUBBER WATER	5880 lbs	13.2	0.000013	-		0.00
OFF GASES	flare liquid lbs/hr	flare gas lbs/hr	total in lbs	4.5 hrs		
C4&+	13.5	25.7	176.2	1	0.000001	0.00
C3&-	0.1	32.8	148.2	0.001	0.000000	0.00

C3&- estim by equilibrium at 1/1000 of the liquid conc

FLUE GAS FROM BAGHOUSE

3060.239 lbs/hr @ 29.884 MW

@ 60 F = 0.069614 lbs/ft³

volumetric rate = 1244.807 m³/hr

CHEMEX @ 430.4465 ug/m³ = 535822.9 ug/hr

= 0.001181 lbs/hr
over

4.5 hours 0.01

END INVENTORY - lbs ----> 443.96

FEED PCB'S ---- lbs ----> 476.82

CLOSURE ----- % -----> 93.11

Total emissions from the:

FLARE STACK: C4&+ 176.2 lbs * <1ppm 0.00017620 lbs

C3&- 148.2 lbs * <1 ppb 0.00000015 lbs

0.00017635 lbs

0.00000001 kgs

TAILINGS: 30,195 lbs tot @ .1ppm = 0.0030195 lbs

0.00137001 kgs

FLUE CYCLONE DUST: 658 lbs * 11.7 ppm = 0.0076986 lbs

0.00349301 kgs

UMATAC atmospheric distillation results gave slightly lower PCB values
in the PCB feed mixture as follows:

Solvents (below 300 deg C B.P.) 2.5ml @ 0.9 S.G. = 2.25 g

PCB's (above 300 deg C B.P.) 17.5ml @ 1.335 S.G. = 23.36 g

23.36/25.61 = 91.2 % PCB's

total 25.61 g

Using this value, the closure on PCB's would be $93.11 \times .939/.912 = 95.87 \%$

PCB ERROR ANALYSIS (mass measurement and laboratory maximum errors)

	mass rate err +/-lbs	mass rate err %	PCB's mass rate err +/-lbs	NAI PCB's lbs	NIN PCB's lbs	lab anal err % std dev	NAI PCB's lbs	NIN PCB's lbs	Comments
PCB FEED	2.18	0.45	1.97	442.77	438.82	1.38	448.87	432.78	
OVHD OIL	62.58	2.44	0.54	22.73	21.65	0.93	24.76	19.72	+/- .5 inches manometer read
SOUR H2O	7.65	2.68	0.00	0.00	0.00	0.93	0.00	0.00	+/- .5 inches manometer read
SIDE DRAW	7.66	7.67	0.00	1.14	0.98	0.93	1.24	0.89	+/- .5 inches manometer read
	0.45	58.00	0.09	0.27	0.09	0.93	0.29	0.00	58 % estimate on pipe inventor
BOTTOMS	7.66	1.00	0.10	9.77	9.57	0.93	10.64	0.72	+/- .5 inches manometer read
	45.85	25.00	0.73	3.65	2.19	0.93	3.97	1.99	25 % estimate on pipe inventor
OVHD OIL	62.58	3.01	1.54	41.85	38.77	0.93	45.58	35.31	+/- .5 inches manometer read
SOUR H2O	7.65	2.68	0.00	0.00	0.00	0.93	0.00	0.00	+/- .5 inches manometer read
		1.00	0.00	0.06	0.06	0.93	0.06	0.05	1 % on weigh scale
SIDE DRAW	24.00	58.00	0.48	1.43	0.48	0.93	1.56	0.43	58 % estimate on pipe inventor
BOTTOMS		1.00	0.69	78.19	68.00	0.93	76.45	62.65	1 % on weigh scale
		1.00	0.44	44.69	43.00	0.93	48.68	39.09	1 % on weigh scale
		1.00	0.72	72.97	71.52	0.93	79.48	65.14	1 % on weigh scale
		1.00	0.69	69.43	68.06	0.93	75.63	61.98	1 % on weigh scale
		1.00	0.53	53.21	52.16	0.93	57.96	47.58	1 % on weigh scale
		1.00	0.57	58.82	56.87	0.93	63.21	51.88	1 % on weigh scale
		1.00	0.87	7.06	6.92	0.93	7.69	6.38	1 % on weigh scale
	37.95	25.00	7.66	28.29	22.97	0.93	41.71	28.92	25 % estimate on pipe inventor
TAILINGS		0.45	0.00	0.00	0.00	0.93	0.00	0.00	varies with feed error by diff
BASHOUSE		1.00	0.00	0.06	0.06	0.93	0.06	0.05	1 % on weigh scale

PCB BALANCE

PCB BAL. VKI

PRINT DATE: 83-JUN-88

TRADE SECRET

TACILK PROCESSOR MASS BALANCE REPORT

RUN DATE May 12, 1988
 WINDOW 28 VERSION 1
 REV 99 PAGE 1

WINDOW 13:24 to 17:26

RUN CONDITIONS

FEED TYPE OIL MIXED WITH SAND + PCB's
 FEED RATE 3.69 tons/hour
 WINDOW LENGTH 4.83
 FEED COMPOSITION (wt%) (lbs/hr)
 PCB 1.6 115.5
 OIL 2.8 286.9
 WATER 1.9 137.9
 MINERAL 93.8 6913.8

RETORT TEMPS (F)

ENTRANCE 1844
 MID-ZONE 1857
 EXIT 1864
 VAPOUR 1878

COMBUSTION TEMPERATURES (F)

ENTRANCE 1287
 MID-ZONE N/A
 EXIT 1269

OIL RECYCLE NO
 RPM @ 4.5

100.0 7374.0

HYDROCARBON BALANCE

STREAM #	STREAM DESCRIPTION	C4&+	C3&-	COKE	C as CO&CO2	
181	FEED			-8.2	-73.6	
187	DIESEL FUEL				-33.5	
119	PROPANE FUEL				-5.2	
152	FLARE GAS	25.7	32.8		36.8	
152	FLARE LIQUID	13.4	8.1			
154	DAYTANK OIL	8.8		8.8		
131	FLUE GAS				122.9	
111	CONV TAILINGS			9.3		
138	FLUE CYCL DUST			8.7		
138	BAGHOUSE DUST			1.6		
189	KILN END LEAK			8.2		
158	HC CYCL DUST			8.7		
157	BOTTOM OIL	131.5		3.6		
126	PREHEAT VENT	8.8				
=====						
	TOTALS (lb/hr)	178.7	32.9	7.9	46.6	= 258.1
	(% OF PRODUCTS)	66.1	12.8	3.1	18.1	= 100.0
	(% OF FEED)	52.9	18.2	2.4	14.5	= 88.1

MINERAL BALANCE

RUN DATE

May 12, 1988

WINDOW

20 VERSION 1

REV

1 PAGE 2

STREAM NUMBER	STREAM DESCRIPTION	SOLIDS (lb/hr)	LOI (wt%)	MINERAL (lb/hr)
111	CONV TAILINGS	6685.9	0.1	6676.6 by difference
130	FLUE CYCL DUST	146.2	0.4	145.5
138	BAGHOUSE DUST	216.0	3.1	51.2
109	KILN END LEAK	104.7	0.2	104.5
150	HC CYCL DUST	190.2	1.4	46.0
157	BOTTOM OIL	47.1	7.6	43.5
154	DAYTANK OIL	0.0	0.0	0.0

WATER BALANCE (See Note 1)

STREAM NUMBER	STREAM DESCRIPTION	RATE (lb/hr)	(wt % of feed)
103	PREHEAT VENT	0.0	0.0
104	RETORT VAPOUR	212.0	153.7
TOTAL		212.0	153.7

Note 1: Problems with the sour water discharge valve during operation required that the water in the overhead separator to be left to accumulate and dumped in batches. It is suspected that this caused an over estimate of the water product and an under estimate of the oil (C4+) product.

MASS BALANCE CALCULATIONS

RUN DATE

May 12, 1968

WINDOW 13:24

17:26 4.83333 hours

WINDOW

20 VERSION

1

REV

99 PAGE

3

FEED RATE

14.8788 tons in 4.83333 hours

3.68788 tons/hour

7374.88 lbs/hr

FEED QUALITY

	(a)	(b)	AVG. mass%	lbs/hr
oil	2.9	2.8	2.85	218.2
water	2.8	1.8	1.9	148.1
solids	95.1	95.4	95.25	7823.7

PCB's 469.2 lbs in 4 hours = 117.3

PCB 117.3 1.57 7491.38

oil 218.2 2.81

water 148.1 1.87

solids 7823.7 93.76

Bottoms OIL 995.2 lbs in 4.83333 hours = 246.7 lbs/hr

TIF 19.87 % solids = 47.1 lbs/hr

clean = 199.7 lbs/hr

SOLIDS	COLLECT lbs	TIME hours	RATE lbs/hr	LOI %	COKE lbs/hr	SOLIDS lbs/hr
--------	----------------	---------------	----------------	----------	----------------	------------------

kiln and leak	184.7	1	184.7	8.236	8.2	184.5
---------------	-------	---	-------	-------	-----	-------

HC cyclone	198.2	4.25	46.6	1.44	8.7	46.8
------------	-------	------	------	------	-----	------

flue gas cyclone	146.2	1	146.2	8.448	8.7	145.5
------------------	-------	---	-------	-------	-----	-------

baghouse	216.83	4.89	52.8	3.894	1.6	51.2
----------	--------	------	------	-------	-----	------

bottoms oil	47.8548	1	47.1	7.6	3.6	43.5
-------------	---------	---	------	-----	-----	------

347.1

clean tailing sand = 7823.7 - 347.1 = 6676.6

LOI on tailings (mass%) 8.139

coke on tails = 9.3

C as CO, CO2

	time	Igal	Igal	temp	API	SG
diesel	13:30	14827.9	1	60	41	0.82828
	17:30	14846.8	18.9	60	41	0.82828

time = 4 hours

rate = 38.8 lbs/hr

C as CO, CO2 = 33.5

H2 = 5.3

propane (fuel not measured, use previous run ratios)

	diesel	propane
871112v28	43.8	8.6 lbs/hr of C as
871112v38	66.4	8.6 CO and CO2

	55.1	8.6

so use propane C as CO, CO2 as	5.2 lbs/hr
so overall propane rate =	6.4 lbs/hr
and H2 =	1.2 lbs/hr

LOI weight % on oil mix feed solids extracted by Dean&Stark

feed	(a)	(b)	
	1.245		
	1.777		
	1.828		
		AVG=	1.165 wt %

C as CO, CO2 or COKE on feed	81.8 lbs/hr
------------------------------	-------------

OILS

overall inventory change yields	178.6 lbs/hr
bottoms oil solids =	47.1 lbs/hr
clean oil product =	131.5 lbs/hr

CHEMEX

Labs Alberta (1984) Ltd.

☐ CALGARY
3001 - 41 AVENUE N.E.
CALGARY, ALBERTA, CANADA T2P 6P1
TELEPHONE (403) 261-8077
TELEX 800-8861

☐ EDMONTON
3001 - 48 STREET
EDMONTON, ALBERTA, CANADA T6B 2N4
TELEPHONE (403) 464-8877

☐ GRANDE PRAIRIE
7100 - 112 STREET
GRANDE PRAIRIE, ALBERTA, CANADA T0V 2N4
TELEPHONE (403) 539-0517

☐ HIGH LEVEL
1000 - 30 STREET
HIGH LEVEL, ALBERTA, CANADA T0H 1Z3
TELEPHONE (403) 998-9448

CERTIFICATE OF ANALYSIS

• GAS • WATER • OIL • SOILS • VEGETATION • ENVIRONMENTAL ANALYSIS

UMATAC INDUSTRIAL PROCESSES

DATE JULY 5, 1988 KB

PROJECT NO. UMAT010 1001 88-4563

LONG RUN PCB BURN MAY 12/88

<u>SAMPLE DESCRIPTION</u>	<u>TOC%</u>
H. CYCLONE 1530-1730	2.22
OILY SAND 1030-1800 A	3.00
OILY SAND 1030-1800 B	2.95
SAG HOUSE FINES 1530-1730	0.67
KILN END COMP. 1400-1730	0.13
TAILINGS COMP. 1400-1730	0.06
BLUE CYCLONE COMP. 1400-1730	0.15

<u>SAMPLE DESCRIPTION</u>	<u>TOLUENE INSOLUBLES %</u>
BOTTOM OIL 1540 & 1647	20.7
BOTTOM OIL 1200	18.3
BOTTOM OIL 1725	0.10
BOTTOM OIL 1730	0.07
BOTTOM OIL 1810	0.35
BOTTOM OIL 1830	0.07
BOTTOM OIL STARTING INVENTORY 1340	18.2

<u>SAMPLE DESCRIPTION</u>	<u>% OIL</u>	<u>% WATER</u>	<u>% SOLIDS</u>
FEED OILY SAND (A)	2.8	1.5	95.7
FEED OILY SAND (B)	2.7	1.7	95.6

9-21-84

Certified by

TRADE SECRET

**APPENDIX
B**

APPENDIX B
ANALYTICAL RESULTS

TRADE SECRET

TEST 1

ANALYTICAL RESULTS
CHEMEX LABS ALBERTA, INC.

TRACE SECRET

CHEMEX

Labs Alberta Inc.

April 19, 1988

UMATAC Industrial Processes

Attention: W. Taciuk

PCB run

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>PCB Analysis</u>
Off gas sampler liquid	880419	1930	- 1 ppm
Baghouse fines, top 1/3 of barrel	880419	mid-end of PCB spike	195 ppm
PCB feed (oil)	880419	1800	95%
Preheat seal condensate	880419	16:16-20:00	1.9 ppm Z
Side draw final end inventory	880419	20:00 final inventory	19,870 ppm
Overhead oil final inventory	880419	20:00 final inventory	9830 ppm
Bottoms oil SBL #3	880419	19:20	65,350 ppm
Bottom Oil	880419	18:50	69,050 ppm
Tailings sand	880419	18:30	- 0.1 ppm
PCB feed (oil)	880419	17:00	92%
Sour H ₂ O water portion (36.4 mls)	880419	17:08-18:37	13.4 ppm
oil portion 2.9 mls			1850 ppm
Bottoms oil SBL #1	880419	18:40	62,040 ppm

...continued

CALGARY
EDMONTON
GRANDE PRAIRIE
RAINBOW LAKE
ESTEVAN, SASK.

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8331 - 48 Street, Edmonton, Canada T6B 2P4 Tel: (403) 485-0877 Fax: (403) 485-3332
8106, 8802 - 112th Street, Grande Prairie, Canada T8V 5X4 Tel: (403) 833-0277
a/o General Delivery, Rainbow Lake, Canada T0H 2Y0 Tel: (403) 856-3381
Banff Avenue & Highway 68 Aurora 1-(403)-851-4223
Aurora 2-(403)-851-4223

W. Taciuk

....2

Flue gas cyclone	880419	18:00	30 ppm
Flare gas XAD ² Resin 240 litres of gas	880419	16:53-18:13	- 0.12 ug/cu ¹
Stack gas XAD ² Resin 233 litres of gas	880419	16:20-18.20	- 0.12 ug/cu ¹
Preheat Zone build-up (hot end)	880419		27 ppm
Preheat zone build-up	880419		17,700 ppm
Hydrocarbon cyclone	880419		- 0.1 ppm
Flare line condensate end of inventory	880419		- 1.0 ppm
Bottoms oil BBL #2	880419	19:00 hrs.	69,200 ppm
Sour water final inventory	880419	20:00 hrs. (92mls)	3.0 ppm

* All PCB was identified as 1242, there was no indication of any other
arochlors present.

** The detection limit on this sample can be improved and is currently being
reprocessed.

TRADE SECRET

TEST 2

ANALYTICAL RESULTS
CHEMEX LAB ALBERTA, INC.

TRADE SECRET

CHEMEX

Labs Alberta Inc.

UMATAC INDUSTRIAL PROCESSES

UMAT010 1001 88-7214

ATTENTION: B. TACIUK

	TIME	SAMPLE TYPE	PCB's ppm (wt/wt)	AROCLOR TYPE
FEED OIL	----	OIL	948,400	1242
BOTTOMS OIL	1340	OIL	16,200	1242
SIDE DRAW OIL	1340	OIL	10,600	1242
OVERHEAD OIL	1340	OIL	8,680	1242
SOUR H ₂ O (NO OIL)	1630-1725	WATER	26.5 (wt/vol)	1242
SOUR H ₂ O (NO OIL) END INV.	1820	WATER	7.64 (wt/vol)	1242
BOTTOM OIL	1540 & 1647	OIL	142,400	1242
BOTTOM OIL	1700	OIL	156,900	1242
BOTTOM OIL	1725	OIL	201,900	1242
BOTTOM OIL	1730	OIL	184,300	1242
BOTTOM OIL	1810	OIL	134,400	1242
BOTTOM OIL	1830	OIL	127,100	1242
BOTTOM OIL COMPOSITE	----	OIL	179,794	1242
SAMPLER LIQUID SCMB	----	OIL	-1	1242
OVERHEAD - END INV.	1820	OIL	24,600	1242


FOU PON

NOTE: MINUS SIGN (-) DENOTES "LESS THAN".

FP/K3

CALGARY
EDMONTON
GRANDE PRAIRIE
RAINBOW LAKE

STETTLE
ESTEVAN, SASK.

2021 - 41 Avenue N.E., Calgary, Canada T2E 6P2 Tel: (403) 291-3077 Fax: (403) 291-9468
9331 - 48 Street, Edmonton, Canada T6B 2R4 Tel: (403) 465-9877 Fax: (403) 466-3332
#105, 9502 - 112th Street, Grande Prairie, Canada T6V 5X4 Tel: (403) 532-0227
c/o General Delivery, Rainbow Lake, Canada T0H 2Y0 Tel: (403) 958-3351
Bank Avenue & Highway 58 Aurora 1-(403) 551-4223
Bay 6, #707 - 42 Street Stettler, Canada T0C 2T0 Tel: (403) 742-1107
Apex Analytical Laboratories Ltd., 483 Dryden St., Estevan, Canada Tel: (306) 834-8112

TRADE SECRET

CHEMEX

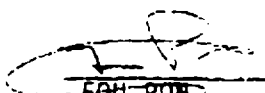
Labs Alberta (1984) Ltd.

UMATAC INDUSTRIAL PROCESSES

UMAT010 1001 88-7214

ATTENTION: B. TACIUK

	SAMPLE TYPE	PCBs ppm (wt/wt)	AROCLOR
SCRUBBER H ₂ O - COMP.	WATER	0.044 (wt/vol)	1242
PREHEAT SEAL CONDENSATE	WATER	738 (wt/vol)	1242
TAILINGS SAND	SOLIDS	0.2	1242
FLUE CYCLONE	SOLIDS	11.7	1242
KILN END LEAK	SOLIDS	0.1	1242
BAGHOUSE	SOLIDS	240	1242
HC - CYCLONE	SOLIDS	1.	1242
XAD ON SCRUBBER 90 ft ³	XAD RESIN	6.0 micrograms	1242
MOD MM5 BAGHOUSE 90 FT ³	XAD RESIN	1980 micrograms	1242
FLARE STACK 7201	XAD RESIN	NO PCB'S	---


FOU-PON

FP/KB

CALGARY 2021 - 41 Avenue NE, Calgary, Canada T2E 5P2 Tel: (403) 291-3077
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GRANDE PRAIRIE #105 8502 - 112th Street, Grande Prairie, Canada T8V 5X4 Tel: (403) 522-0227
HIGH LEVEL 10509 - 45 Street, High Level, Canada T0H 1Z0 Tel: (403) 925-2448
ESTEVAN, SASK Apex Analytical Laboratories Ltd., 483 Devonian St., Estevan, Canada Tel: (306) 634-8112

TRANS 9/2/88

TEST 2

PRELIMINARY ANALYTICAL RESULTS
POLYCHLORINATED BIPHENYLS
CLAYTON ENVIRONMENTAL CONSULTANTS, INC.

TRAIN SECRET

VERBAL ANALYTICAL RESULTS
CLAYTON ENVIRONMENTAL CONSULTANTS, INC.
TEST 2

<u>Sample Description</u>	<u>PCB Conc.</u>	<u>Aroclor</u>
PCB Oil Feed Composite	520 mg/g	1242
Kiln End Leakage Composite	0.3 ug/g	1242
Scrubber Liquid Composite	0.15 mg/l	1242
Baghouse Fines Composite	170 ug/g	1248
Flue Gas Cyclone Fines Composite	11 ug/g	1248
Overhead Oil Composite	21 mg/g	1242
Tailings Discharge Composite	<0.3 ug/g	1242
Sour Water Composite	0.033 mg/l	1232
Bottoms Oil Sidedraw Oil Composite	91 mg/l	1242
H.C. Cyclone Fines Composite	<0.3 ug/g	1242
Unspiked Sand Feed Composite	<0.3 ug/g	1242

TABLE 1

TEST 2

PRELIMINARY ANALYTICAL RESULTS
DIOXINS AND FURANS
CLAYTON ENVIRONMENTAL CONSULTING, INC.

TRADE SECRET

VERBAL ANALYTICAL RESULTS
CLAYTON ENVIRONMENTAL CONSULTANTS, INC.
TEST 2

	PCB Oil Feed Composite <u>ng/gm</u>	Tailings Discharge Composite <u>ng/gm</u>	Unspiked Sand Feed Composite <u>ng/gm</u>
2,3,7,8-Tetrachlorodibenzo-p-dioxin	-	-	-
Total Tetrachlorodioxins	-	-	-
2,3,7,8-Tetrachlorodibenzo-p-furan	95	0.43	-
Total Tetrachlorofurans	370	2.5	-
Total Pentachlorodioxins	-	-	-
Total Pentachlorofurans	250	-	-
Total Hexachlorodioxins	-	-	-
Total Hexachlorofurans	56	-	-
Total Heptachlorodioxins	-	-	-
Total Heptachlorofurans	37	-	-
Total Octachlorodioxins	-	-	-
Total Octachlorofurans	-	-	-

Dash (-) denotes below detectable limits. Detection limits not available with the preliminary results.

TRADE SECRET

APPENDIX
C

APPENDIX C
FLUE GAS AND FLARE GAS ANALYSIS

TRADE SECRET

TEST 1

PRELIMINARY FLUE GAS RESULTS
FURANS AND DIOXINS
CLAYTON ENVIRONMENTAL CONSULTANTS, INC.

TRADE SECRET

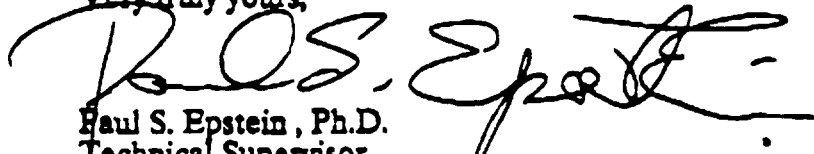
Ms. Irene Fanelli
CANONIE ENVIRONMENTAL
1825 South Grant St., Ste. 260
San Mateo, CA 94402

Dear Ms. Fanelli:

Here are the preliminary results on the MM5 stack train. The samples were combined into two fraction. Fraction one was the XAD-resin and the filter. Fraction two was the liquid samples and washes.

	XAD ng	Washes ng
2,3,7,8-tetrachlorodibenzo-p-dioxin	<11	<9
Total tetrachlorodibenzodioxins	<11	<9
2,3,7,8-tetrachlorodibenzofuran	12	10
Total tetrachlorodibenzofurans	124	105
Total pentachlorodibenzodioxins	<2	<.7
Total pentachlorodibenzofurans	<2	3
Total hexachlorodibenzodioxins	<.5	<.8
Total hexachlorodibenzofurans	<.3	<.3
Total heptachlorodibenzodioxin	<1.3	<1.1
Total heptachlorodibenzofurans	<.8	<.5
Octachlorodibenzodioxin	<20	<30
Octachlorodibenzofuran	<7	<12

Very truly yours,


Paul S. Epstein, Ph.D.
Technical Supervisor
/PSE

TRADE SECRET

TEST 1

FINAL FLUE GAS RESULTS
FURANS AND DIOXINS
CLAYTON ENVIRONMENTAL CONSULTANTS, INC.

TRADE SECRET

Clayton Environmental Consultants, Inc.

22345 Roethel Drive • Novi, Michigan 48050 • (313) 344-1770

June 14, 1988

Ms. Irene Fanelli
CANONIE ENVIRONMENTAL SERVICES
1825 South Grant Street
Suite 260
San Mateo, CA 94402

Clayton Project No. 48641-17
Final Report

Dear Ms. Fanelli:

The following is our final report for the samples submitted on April 28, 1988 for the determination of polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).


The samples were analyzed following a method based on the U.S. Environmental Protection Agency (EPA) Region VII method "Determination of 2,3,7,8-TCDD in Soil and Sediment (Revised September 1983)" and U.S. EPA Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Method 8280, SW-846, Third Edition. A summary of the methodology and quality assurance is enclosed.

There were detectable amounts of PCDFs found in both composited samples. A summary of the results is provided in the enclosed table.

The dioxin equivalency calculations are based on formulas from "Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and -Dibenzofurans (CDDs and CDFs), U.S. EPA 625/3-87/012." The calculations are made on a "worst-case basis." The limit of detection for each congener was used if PCDD or PCDF was not detected.

If you have any questions, please call Paul Epstein at (313) 344-1770.

Sincerely,


Robert Lieckfield Jr., C.I.H.
Manager, Laboratory Services

RL:kf
Enclosure

Analytical Results
for
CANONIE ENVIRONMENTAL SERVICES
Clayton Project No. 48641-17

Lab Number: Sample Description:	631669 Composite 88-0279-40 88-0279-44	631670 Composite 88-0279-41 88-0279-42 88-0279-45	631672 Composite 88-0279-43 (Blank) 88-0279-46
<u>Compound</u>	<u>(ng)</u>	<u>(ng)</u>	<u>(ng)</u>
2,3,7,8-tetrachlorodibenzo-p-dioxin	<11	<9	<0.41
Total tetrachlorodibenzodioxins	<11	<9	<0.41
2,3,7,8-tetrachlorodibenzofuran	12	10	<0.23
Total tetrachlorodibenzofurans	120	100	<0.23
Total pentachlorodibenzodioxins	<1.5	<0.7	<3.5
Total pentachlorodibenzofurans	<2.2	3	<0.54
Total hexachlorodibenzodioxins	<0.53	<0.83	<0.99
Total hexachlorodibenzofurans	<0.26	<0.27	<0.5
Total heptachlorodibenzodioxin	<1.3	<1.1	<1.7
Total heptachlorodibenzofurans	<0.81	<0.55	<0.77
Octachlorodibenzodioxin	<20	<30	<11
Octachlorodibenzofuran	<6.9	<12	<4
Dioxin Equivalency Calculation	13	11	2.3

TRADE SECRET

CANONIE ENVIRONMENTAL SERVICES
Clayton Project No. 48641-17

Methodology
for Analysis of
PCDD/PCDF

Extraction

Sorbent Tubes

The XAD portion of each sorbent tube was spiked with 100 microliters (uL) of the isotopically-labeled internal standards and surrogate solution and extracted for 18 hours with toluene in a Soxhlet extractor. The extracts were reduced to 1 milliliter (mL) on a rotary evaporator at 55 °C.

Liquid Samples

Each liquid sample was serially extracted three times with methylene chloride. The extracts were then combined and reduced to 1 mL on a rotary evaporator at 55 °C.

Cleanup

The extracts were washed in a 20% potassium hydroxide/water solution and then in concentrated sulfuric acid. The extract was transferred to a 20-millimeter (mm) outside diameter (OD) x 230-mm glass column packed with a glass wool plug followed successively by 1.0 gram (g) of silica gel, 2.0 g of silica gel containing 33% (w/w) 1 M sodium hydroxide (NaOH), 1.0 g of silica gel, 4.0 g of silica gel containing 44% (w/w) concentrated sulfuric acid (H₂SO₄), and 2.0 g of silica gel.

The sample aliquots were eluted with 90 mL of hexane. The eluates were collected and reduced to less than 1 mL in a rotary evaporator. The concentrated eluates were then transferred to mini-columns consisting of a 10-mL disposable pipette plugged with silanized glass wool and packed with 1 g of Woelm basic alumina (activated at 600 °C for 24 hours).

The sample extracts were transferred to the top of the mini-column and eluted with 5 mL of 3% (v/v) methylene chloride in hexane (discarded), followed by 20 mL of 50% (v/v) methylene chloride in hexane. The 50% eluate was collected and reduced to less than 1 mL in a rotary evaporator.

The concentrated eluates were transferred to mini-columns consisting of a 10-mL disposable pipette plugged with silanized glass wool and packed with 2 cm of an 18% Carbopack C on Celite 545 mixture. This column was preeluted with 20 mL of toluene followed by 1 mL of 75:20:5 methylene chloride/methanol/benzene, 1 mL of 1:1 cyclohexane in methylene chloride, and 2 mL of hexane. The extract was then added to the column and sequentially eluted with two 1-mL aliquots of hexane, 1 mL of 1:1 cyclohexane in methylene chloride, and 1 mL of 75:20:5 methylene chloride/methanol/benzene. The PCDD/PCDF fraction was then collected by elution with 2 mL of toluene.

TRADE SECRET

CANONIE ENVIRONMENTAL SERVICES
Clayton Project No. 48641-17

The retained eluates (PCDD/PCDF fraction) were concentrated to near dryness and brought to a final volume of 20 uL with isooctane for analysis.

Instrument Conditions

The cleaned extracts were analyzed and data acquired on an HP 5970 quadrupole gas chromatograph/mass selective detector (GC/MSD) operating in the selected ion monitoring (SIM) mode. The instrument parameters are listed below.

Column:	Hewlett Packard 30 m SE-54
Carrier Gas:	He @ 5 psi Head Pressure
GC:	HP 5890
Mode:	SIM Electron Impact
Injection Port Temperature:	300 °C
Splitless Time:	0.75 min
GC Program:	100 to 300 @ 20 °C/min
Hold:	300 °C
Electron Multiplier:	3,000 V
Emission Current:	300 mA
Injection Volume:	2 uL splitless

At least three ions were monitored for each congener group. One ion was also monitored for the chlorinated diphenyl ethers which are interferences for the PCDFs in this analysis. Table I lists the ions monitored and the group switch points for the different congener groups.

Linearity

Linearity for the congener groups was determined by injecting a set of calibration standards at the 10-, 50-, 100-, 250-, and 500-picograms per microliter (pg/uL) levels of the native isomer. Response factors (RF) for each compound in the standard mixtures were calculated using the following formula:

$$\frac{(\text{Area Ion I} + \text{Area Ion II}) \times \text{Amt Labeled Std Ion}}{\text{Area Std Ion I} + \text{Area Std Ion II}) \times \text{Amt Native Std}} = \text{RF}$$

An average response factor for the compound was calculated from the five-level linearity set.

TOP SECRET

Table I
Masses and Windows for the Determination
of PCDDs and PCDFs

<u>Compound</u>	<u>Mass 1</u>	<u>Mass 2</u>	<u>Mass 3</u>	<u>Ratio M1/M2</u>	<u>Window Start/Stop (min)</u>
Tetrachlorodibenzodioxin	320	322	259	0.77	10/13.3
Tetrachlorodibenzofuran	304	306	241	0.77	10/13.3
¹³ C-tetrachlorodibenzodioxin	332	334	---	0.77	10/13.3
³⁷ Cl-tetrachlorodibenzodioxin	328	---	---	---	10/13.3
¹³ C-pentachlorodibenzodioxin	368	370	---	1.54	13.3/15.6
Pentachlorodibenzodioxin	356	358	293	1.54	13.3/15.6
Pentachlorodibenzofuran	340	342	275	1.54	13.3/15.6
¹³ C-hexachlorodibenzodioxin	402	404	---	1.23	15.6/18
Hexachlorodibenzodioxin	390	392	327	1.23	15.6/18
Hexachlorodibenzofuran	374	376	311	1.23	15.6/18
¹³ C-heptachlorodibenzodioxin	436	438	---	1.03	18/23
Heptachlorodibenzodioxin	424	426	361	1.03	18/23
Heptachlorodibenzofuran	408	410	345	1.03	18/23
¹³ C-octachlorodibenzodioxin	470	472	---	0.88	23/26
Octachlorodibenzodioxin	458	460	395	0.88	23/26
Octachlorodibenzofuran	442	444	379	0.88	23/26

TRADE SECRET

CANONIE ENVIRONMENTAL SERVICES
Clayton Project No. 48641-17

Compound Identification Criteria

In order for a compound to be reported, it must pass the following criteria:

- (1) All ions measured must be present and maximize within 2 seconds of each other.
- (2) Measured isotopic abundance ratios must be within $\pm 15\%$ of the theoretical ratio.
- (3) The signal to noise ratio of the corresponding standard must be greater than 5 to 1.

Detection Limits

In cases where no congeners were detected, detection limits were calculated using one of the following methods:

- When no peaks were detected in the window at either ion:

$$\frac{(\text{RMS Ion I} + \text{RMS Ion II}) \times 2.5 \times \text{Amt Std}(\text{ng})}{\text{HSTD Ion I} + \text{HSTD Ion II} \times \text{RRF}(\text{avg})} = \text{Detection Limit}(\text{ng})$$

Where:

RMS Ion I = root mean square noise average for interval around Ion I

Amt Std(ng) = nanogram of added internal standard

HSTD Ion I = height of peak for standard Ion I

RRF(avg) = average response factor for congener group

- When no peaks were detected in the window for one ion and interferences were present in the window of the second ion:

$$\frac{(\text{RMSW}) \times 2.5 \times \text{Amt Std}(\text{ng})}{(\text{HSTD Ion I} + \text{HSTD Ion II}) \times \text{RRFW}} = \text{Detection Limit}(\text{ng})$$

Where:

RMSW = RMS noise in ion interval for ion without interference

RRFW = Single ion response factor for ion without interference

- Where coeluting peaks were detected in both ion windows that did not match correct abundance ratios:

$$\frac{\text{Area S} \times \text{Amt Std}(\text{ng})}{(\text{Area STD Ion I} + \text{Area STD Ion II}) \times \text{RRFS}} = \text{Detection Limit}(\text{ng})$$

Where:

Area S = area of smaller ion with interference

RRFS = single ion response factor

TRADE SECRET

CANONIE ENVIRONMENTAL SERVICES
Clayton Project No. 48641-17

- Where coeluting peaks were detected in both ion windows that did not match correct abundance ratios:

$$\frac{\text{Area S} \times \text{Amt Std (ng)}}{(\text{Area STD Ion I} + \text{Area STD Ion II}) \times \text{RRFS}} = \text{Detection Limit (ng)}$$

Where:

Area S = area of smaller ion with interference
RRFS = single ion response factor

Calculation Methods

When coeluting peaks exhibited the correct isotope abundance ratio, the amount in the sample was calculated using the following formula:

$$\frac{(\text{Area Ion I} + \text{Area Ion II}) \times \text{Amt Std (ng)}}{(\text{Area Std Ion I} + \text{Area Std Ion II}) \times \text{Avg RRF}} = \text{Amt (ng)}$$

Surrogate amounts were calculated using the following formula which corrects for the contribution to mass 328 of any native 2,3,7,8-TCDD:

$$\frac{(\text{Area 328} - 0.009 \times \text{Area 322}) \times \text{Amt Std (ng)}}{(\text{Area 332} + \text{Area 334}) \times \text{RRF } ^{37}\text{Cl 2,3,7,8-TCDD}} = \text{Amt (ng) } ^{37}\text{Cl-TCDD}$$

Quality Control

A matrix spike sample was analyzed with the batch of samples. These results and the surrogate recovery results are presented in Tables II and III. The results for the blanks are presented in Table IV.

TRADE SECRET

CANONIE ENVIRONMENTAL SERVICES
Clayton Project No. 48641-17Table II
Matrix Spike Results

<u>Compound</u>	<u>Recovery (%)</u>
2,3,7,8-tetrachlorodibenzo-p-dioxin	99
Total tetrachlorodibenzodioxins	99
2,3,7,8-tetrachlorodibenzofuran	82
Total tetrachlorodibenzofurans	96
Total pentachlorodibenzodioxins	91
Total pentachlorodibenzofurans	90
Total hexachlorodibenzodioxins	110
Total hexachlorodibenzofurans	56
Total heptachlorodibenzodioxin	96
Total heptachlorodibenzofurans	96
Octachlorodibenzodioxin	ND
Octachlorodibenzofuran	74

ND = Compound not detected in spike.

TRADE SECRET

CANONIE ENVIRONMENTAL SERVICES
Clayton Project No. 48641-17

Table III
Surrogate Recoveries

<u>Lab Number</u>	<u>Sample Description</u>	<u>³⁷Cl- TCDD (%)</u>
631669	Composite 88-0279-40 88-0279-44	84
631670	Composite 88-0279-41 88-0279-42 88-0279-45	92
631672	Composite 88-0279-43 Blank 88-0279-46	78
--	Matrix Spike	69
--	Lab Blank 1	76
--	Lab Blank 2	83

TRAE SECRET

CANONIE ENVIRONMENTAL SERVICES
Clayton Project No. 48641-17**Table IV**
Blank Results

<u>Compound</u>	<u>Lab Blank 1 Sorbent (ng)</u>	<u>Lab Blank 2 Liquid (ng)</u>
2,3,7,8-tetrachlorodibenzo-p-dioxin	<0.59	<0.53
Total tetrachlorodibenzodioxins	<0.59	<0.53
2,3,7,8-tetrachlorodibenzofuran	<0.32	<0.31
Total tetrachlorodibenzofurans	<0.32	<0.31
Total pentachlorodibenzodioxins	<1.1	<1.1
Total pentachlorodibenzofurans	<0.93	<0.71
Total hexachlorodibenzodioxins	<1.1	<1.6
Total hexachlorodibenzofurans	<0.44	<0.67
Total heptachlorodibenzodioxin	<2.4	<2.9
Total heptachlorodibenzofurans	<1.1	<1.5
Octachlorodibenzodioxin	<12	<16
Octachlorodibenzofuran	<5.5	<6.9

TRADE SECRET

TEST 1

FLUE GAS RESULTS
FURANS AND DIOXINS
CHEMEX LABS ALBERTA, INC.

TRADE SECRET

CHEMEX

Labs Alberta Inc.

UMATAC Industrial Processes

Attention: W. Taciuk

Furan and Dioxin Analysis of Stack Gas collected on XAD²

Since Chemex Labs Alberta Inc. does not have the facilities to handle furan or dioxin standards, only a qualitative assessment of the presence of these compounds was attempted. In order to perform this assessment, the extraction procedure as outlined in EPA Method 8280 was carried out. The solvent elution known to contain any dioxin or furan compound was then injected into a Hewlett Packard GC/MSN with the following conditions:

GC Parameters,

Initial Temp: 170°C
Initial Hold: 10 min
Ramp Rate: 8°C min⁻¹
Final Temp: 320°C
Final Hold: 20 min

MS Parameters,

Mass range: 35.0 - 450 Amu
Peak threshold: 1500

...continued

Handwritten signature

CALGARY
EDMONTON
GRANDE PRAIRIE
RAINBOW LAKE

2021 - 41 Avenue N.E., Calgary, Canada T2E 0P2 Tel: (403) 291-3077 Fax: (403) 291-8466
8331 - 48 Street, Edmonton, Canada T6B 2R4 Tel: (403) 486-8877 Fax: (403) 486-3333
8108, 8002 - 112th Street, Grande Prairie, Canada T8V 5X4 Tel: (403) 832-0227
c/o General Delivery, Rainbow Lake, Canada T0M 2Y0 Tel: (403) 952-2771
Barr Avenue & Highway 58

VERVIAN 2100

TRADE SECRET

...2

The compounds monitored and their corresponding mass ion ratios were as follows:

<u>Compound</u>	<u>Quantitation Ion and Confirmation Ions</u>
<u>DIOXIN</u>	
TCDD	322, 320, 257
PCDD	356, 354, 358 293
HxCDD	390, 388, 392, 327
MpCDD	424, 422, 426, 361
OCDD	460, 458, 395
<u>FURANS</u>	
TCDF	306, 304, 243
PCDF	340, 338, 342, 277
HxCDF	374, 372, 376, 311
MpOF	408, 406, 410, 345
OCDF	444, 442, 379

TRADE SECRET

L..3

There was no indication of the presence of any of the mass ions associated with the compounds investigated.

If the assumption is made that the GC/MSD responds the same as the GC/MS used to develop EPA 8280, then the detection limits may be assumed approximately as follows: Based on 233 litres of gas,

PCDD - 0.25 ng/cu¹

PCDF - 0.06 ng/cu²

TOP SECRET

TEST 1

FLUE GAS RESULTS
POLYCHLORINATED BIPHENYLS
CLAYTON ENVIRONMENTAL CONSULTING, INC.

TRADE SECRET

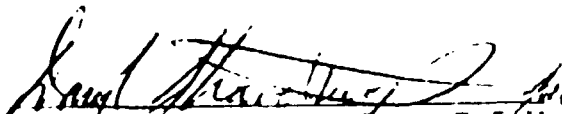
CANONIE ENVIRONMENTAL
Clayton Project No.: 48641-17

Table 2

Lab Number	Sample Description	Polychlorinated Biphenyls	
		Aroclor 1242 (ug)	Aroclor 1254 (ug)
631669	88-0279-40 88-0279-44	100.000	<1
631670	88-0279-41 88-0279-42 88-0279-45	20.000	<1
631672	88-0279-43 88-0279-46	<1	<1
Limit of Detection:		1 ug	1 ug
Analytical Method:		EPA 608	EPA 608

The remaining results will be forwarded upon completion.

It is a pleasure to be of assistance to you. Please contact me at (313) 344-1770 if you have any questions.


Robert Lieckfield Jr., C.I.H.
Manager, Laboratory Services
Novi Office

TRADE SECRET

TEST 2

PRELIMINARY FLUE GAS RESULTS
POLYCHLORINATED BIPHENYLS
CLAYTON ENVIRONMENTAL CONSULTANTS, INC.

TRADE SECRET

CANONIE ENVIRONMENTAL PRELIMINARY RESULTS FOR PCBS
(RESULTS ARE VERBAL)

<u>Client Description</u>	<u>#2,4,5 Composite</u>	<u>#3 (XAD)</u>	<u>UMATAC Filter Blank</u>	<u>UMATAC 12/05/88 (Filter)</u>	<u>H₂O Blank MeOH/MeCl₂ Blank</u>
Clayton Lab No.	640318	640321	640322	640323	640579
	640319				640580
	640320				Composite
	Composite				
PCBs	22 mg/l	2.5 mg/g	<20 ug/gm	80 ug/gm	<0.08 mg/l
	1242	1242	1248	1248	1242

TRADE SECRET

TEST 2

PRELIMINARY FLUE GAS RESULTS
FURANS AND DIOXINS
CLAYTON ENVIRONMENTAL CONSULTANTS, INC.

TRADE SECRET

Canonie Enviro Dioxin Preliminary Results

6/14/88

Client Description

Clayton Lab #.

#34,5 Composite	#3	IMATAC FILTER BLANK	IMATAC 12/05/88	H ₂ O BLANK
640318	640321	640022	640320	640579
640319				640580
640320 composite				Composite
(ng/mL)	(ng/gm)	(ng/gm)	(ng/gm)	(ng/mL)
<0.0023	<1.1	<5.5	<2.3	<0.0042
<0.0023	<1.1	<5.5	<2.3	<0.0042
0.19	21	<2.8	79	<0.0018
1.4	690	<2.8	520	<0.0018
<0.0014	<2.4	<9.7	<2.4	<0.0066
<0.078	<3.0	<6.0	37	<0.0057
<0.0010	<2.1	<7.4	<1.2	<0.0050
<0.0052	<0.89	<4.5	<0.62	<0.0030
<0.0018	<0.82	<1.0	<1.1	<0.0059
<0.0019	<1.2	<7.7	<0.87	<0.0040
<0.0071	<0.84	<39	<4.2	<0.024
<0.0046	<0.10	<18	<2.1	<0.012

2,3,2,8-Tetrachlorodibenzo(p,dioxin)

& Tetrachlorodioxins

2,3,7,8-Tetrachlorodibenzo(p,furan)

Total Tetrachlorofurans

Total Pentachlorodioxins

Total Pentachlorofurans

Total Hexachlorodioxins

Total Hexachlorofurans

Total Heptachlorodioxins

Total Heptachlorofurans

Total Octachlorodioxins

Total Octachlorofurans

↑	↑	↑
IMPINGEMENT LIQUIDS	XAD	FILTER
450 ml	11.68 gm	0.14 gm

VOLUME FLUE GAS = 160 S.C.F.

THREE

APPENDIX D
RESULTS OF PERSONNEL MONITORING

TRADE SECRET

APPENDIX

D

TEST 1

PERSONNEL MONITORING RESULTS
POLYCHLORINATED BIPHENYLS
CLAYTON ENVIRONMENTAL CONSULTANTS, INC.

TRADE SECRET

CLAY

VIRONMENTAL CONSULTANTS

Analytical Laboratory Report

Ms. Irene Fanelli
Health & Safety
CANONIE ENVIRONMENTAL
1825 South Grant Street, Suite 260
San Mateo, CA 94402

Date Reported: 16-MAY-88
Date Received: 28-APR-88
Clayton Project No.: 48641-17
Partial Report

Dear Ms. Fanelli:

The following is our report on the samples submitted for analysis.

RECEIVED

MAY 20 1988

Ans'd.....

Table 1

Polychlorinated Biphenyls

Lab Number	Sample Description	Air Volume (liters)	Aroclor 1242				Aroclor 1254			
			Tube (ug)	Filter (ug/m3)	Tube (ug)	Filter (ug/m3)	Tube (ug)	Filter (ug/m3)	Tube (ug)	Filter (ug/m3)
631660	ISF418 1A & B	152	<0.07	<0.5	<0.7	<5	<0.07	<0.5	<0.2	<1
631661	ISF418 2A & B	172	<0.07	<0.4	<0.2	<1	<0.07	<0.4	<0.2	<1
631662	ISF418 3A & B	170	<0.07	<0.4	<0.2	<1	<0.07	<0.4	<0.2	<1
631663	ISF418 4A & B	148	<0.07	<0.5	<0.2	<1	<0.07	<0.5	<0.2	<1
631664	BLANK	--	<0.07	--	<0.2	--	<0.07	--	<0.2	--
631665	ISF 419 1A & B	--93	<0.07	--<0.8	<0.2	--<2	<0.07	--	<0.2	--
631666	ISF 419 2A & B	--93	<0.07	--<0.8	<0.2	--<2	<0.07	--	<0.2	--
631667	ISF 419 3A & B	--102	<0.07	--<0.7	<0.2	--<2	<0.07	--	<0.2	--
631668	ISF 419 4A & B	--93	<0.07	--<0.8	<0.2	--<2	<0.07	--	<0.2	--

Limit of Detection: 0.07 ug
Analytical Method (NIOSH): 5503

0.2 ug
5503

0.07 ug
5503

0.2 ug
5503

TRADE
SECRET

APPENDIX
E

APPENDIX E
CHAIN-OF-CUSTODY RECORDS FOR SAMPLES

TRADE SECRET

TEST 1
CHAIN-OF-CUSTODY RECORDS

TRADE SECRET

SAMPLE CUSTODY SHEET
UMATAC PCB RUN

1061

Sample Description :

Filter from MM5 train

Identification Number :

✓

88-0279-40

Date :

April 19/88

Time :

16:20 - 18:20

Sampled By :

W Book

Received By :

N Moffat

SUBSEQUENT ANALYSIS

Date and Time

In Custody of

Purpose

52

F1/BX
VAM

4841-1711
TRADE SECRET

SAMPLE CUSTODY SHEET

UMATAC PCB RUN

ND 64

0901

Sample Description :

CONTAINER # 4

CONDENSATE

MMS train

Identification Number :

✓ (88-0279-41)

Date :

April 19/88

Time :

16:20 - 18:20

Sampled By :

W Book

Received By :

N Myffat

SUBSEQUENT ANALYSIS

Date and Time

In Custody of

Purpose

(62)

48641-17 NII
TRADE SECRET

SAMPLE CUSTODY SHEET
UMATAC PCB RUN

Sample Description : CONTAINER #2 Front Wash
MMS train

Identification Number : ✓ (88-0279-42)

Date : April 19/88

Time : 16:20 - 18:20

Sampled By : W. Book

Received By : N. Muffet

SUBSEQUENT ANALYSIS

Date and Time

In Custody of

Purpose

(20)

2103

48641-01M

^{C2}
TRADE SECRET

SAMPLE CUSTODY SHEET
UMATAC PCB RUN

Sample Description : Methanol, Methylene Chloride
Blank, MMS train.

Identification Number :

✓ 88-0279-43

Date :

Time :

Sampled By :

W. Book

Received By :

R. Moffat

SUBSEQUENT ANALYSIS

Date and Time

In Custody of

Purpose

30

48641-7K
TRADE SECRET

SAMPLE CUSTODY SHEET
UMATAC PCB RUN

Sample Description :

CONTAINER #3 XAD 2 Resin
mm5 train

Identification Number :

✓ 88-0279-44

Date :

April 19/88

Time :

16:20 - 18:20

Sampled By :

W. Book

Received By :

M. Maffei

SUBSEQUENT ANALYSIS

Date and Time

In Custody of

Purpose

(30)

48641-001
TRADE SECRET

SAMPLE CUSTODY SHEET
UMATAC PCB RUN

Sample Description :

CONTAINER # 5 Back Rinse
mm 5 train

Identification Number :

✓ (88-0279-45)

Date :

April 19/88

Time :

16:20 - 18:20

Sampled By :

W Book

Received By :

N Maffa

SUBSEQUENT ANALYSIS

Date and Time

In Custody of

Purpose

(30)

48641-Tin
TRADE SECRET

SAMPLE CUSTODY SHEET
UMATAC PCB RUN

Sample Description : Distilled Water Blank

Identification Number :

✓ 88-0279-46

Date :

April 19/88

Time :

16:20 - 18:20

Sampled By :

W. Book

Received By :

N. Nuff

SUBSEQUENT ANALYSIS

Date and Time

In Custody of

Purpose

to

(30)

REC-118641-113
TRADE SECRET

CLAYTON ENVIRONMENTAL CONSULTANTS, INC.

Request for Industrial Hygiene Analytical Laboratory Services

Name Irene Fanelli Title Lab. Safety
 Company Canonic Environmental Services
 Street 1825 S Grant St St 260
 City Waukegan State IL Zip 60087 Phone (815) 573-2012
 Client P.O. Number (will call with #) Prepared by _____
 Sampling date 4/18-19/28 Sampling media glass fiber / 1/2 in
 Results required by normal TA

	Sample Description	Air Volume (give units)	Analyses Requested
79	1 ✓ ISF 412.1A + B	152 liter	Dioxins
5-1/2	2 ✓ ISF 412.2A + B	172	
	3 ✓ ISF 412.3A + B	170	
UNT	4 ✓ ISF 412.4A + B	148	
	5 ✓ BLANK filter	—	
	6 ✓ BLANK tube	—	
	7 ✓ ISF 419.1A + B		
	8 ✓ ISF 419.2A + B		
	9 ✓ ISF 419.3A + B		
	10 ✓ ISF 419.4A + B		
	11 —		
	12 —		

Special Instructions:

filter and tube result may be reported together
Please return a copy of the lab request with the
analytical results

Please return to:

Clayton Environmental Consultants, Inc.
 22345 Roethel Drive
 Novi, MI 48050
 (313) 344-1770

Attn: Laboratory

01/27/88

SAMPLES IN WALK-IN FRIDGE - IN A BLUE COOLER

LAB USE ONLY	
Date Received	RECEIVED 05/05/2005
Project Number	48641-17 N10
Initials	C.R.

TRADE SECRET

TEST 2
CHAIN-OF-CUSTODY RECORDS

TRAE SECRET

CLAYTON ENVIRONMENTAL CONSULTANTS, INC.

Request for Industrial Hygiene Analytical Laboratory Services

MAY 26 1988

CANONIE ENVIRONMENTAL

Name PETER REMICK Title PROJECT ENGINEER
 Company CANONIE ENVIRONMENTAL SERVICES CORP.
 Street 800 CANONIE DRIVE
 City PATER State IN Zip 46304 Phone (317) 996 8651
 Client P.O. Number _____ Prepared by Peter Remick
 Sampling date 5/12/88 Sampling media _____
 Results required by JOE KEAR TURNER/CORP

	Sample Description	Air Volume (give units)	Analyses Requested
	<u>PLB OIL FEED COMPOSITE</u>		<u>ROB, DISKINS, BENZOFURAN</u>
2	<u>KILN END LEAKAGE COMPOSITE</u>		<u>PLB</u>
3	<u>SCRIPPER LEAKAGE COMPOSITE</u>		<u>PLB</u>
4	<u>BAGHOUSE FINES COMPOSITE</u>		<u>PLB</u>
5	<u>FLUE GAS CYCLONE FINES COMPOSITE</u>		<u>PLB</u>
6	<u>OVERHEAD OIL COMPOSITE</u>		<u>PLB</u>
7	<u>TALLER'S DISCHARGE COMPOSITE</u>		<u>PLB, DISKINS, BENZOFURAN</u>
8	<u>SLUR WATER COMPOSITE</u>		<u>PLB</u>
9	<u>PERMITS/SIDE DRAIN OIL COMPOSITE</u>		<u>PLB</u>
10	<u>H.C. LUBING FINES COMPOSITE</u>		<u>PLB</u>
11	<u>UNBURNED AND FEED COMPOSITE</u>		<u>PLB, DISKINS, BENZOFURAN</u>

Special Instructions:

Please a copy of this sheet to Peter Remick when the lab use
only" section is completed.

Please return to:

Clayton Environmental Consultants, Inc.
 22345 Roethel Drive
 Novi, MI 48050
 (313) 344-1770

Attn: Laboratory

7/7/88

LAB USE ONLY	
Date Received	<u>RECEIVED</u>
Project Number	<u>49208-NCR</u>
Initials	_____

5/22/88

TRADE SECRET

LABORATORY REQUEST FORM

Name: Susan Walker
 Company: Canon's Environmental
 Street: 94 INVERNESS TERRACE EAST
 City: Englewood State: CO Zip: 80012
 Phone Number: (303) 790-1747 P.O. No.: 88-050
 Sampling Date: 5/12/88 Sampling Media: Florisil with Glass Fiber Filter

Sample Description:	Air Volume:	Analyses Requested:
1. <u>242/51288 (A) (B)</u>	<u>37 L</u>	<u>PCB 1061</u>
2. <u>698/51288 (A) (B)</u>	<u>40 L</u>	<u>PCB</u>
3. <u>245/51288 (A) (B)</u>	<u>36 L</u>	<u>PCB</u>
4. <u>356/51288 (A) (B)</u>	<u>40 L</u>	<u>PCB</u>
5. <u>BLANK</u>		
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____
11. _____	_____	_____
12. _____	_____	_____
13. _____	_____	_____
14. _____	_____	_____

Special Instruction (method, limits of detection): Please provide safety information below and return copy with sample results.

Signature: Susan Walker

Date: 5/26/88

FOR LAB USE ONLY	Due Date: _____
	Misc: _____

FOR LAB USE ONLY	Date Received: <u>MAY 27 1988</u>
	Job No. <u>49342-17</u>
	Log-in-date: _____

TRADE SECRET

CHEMEX Labs Alberta (1984) Ltd.

**DANGEROUS GOODS
SHIPPING BILL**

00685

CONSIGNOR	
NAME	CHEMEX LABS (0001)
ADDRESS	2021 - 41 AVEENUE, S.E.
CITY, PROV.	WINDSOR ONT N4C 2S9
DATE RECEIVED	DATE SHIPPED
SIGNATURE Pat Dunn	

CONSIGNEE	
NAME	CLAYTON LABS
ADDRESS	40 HURON CHURCH ROAD
CITY, PROV.	WINDSOR ONT N4C 2S9
DATE RECEIVED	RECEIVED BY

CARRIER	<input checked="" type="checkbox"/> TRUCK <input type="checkbox"/> RAIL <input type="checkbox"/> SHIP
COMPANY NAME	LOOMIS
ADDRESS	
CITY, PROV.	POSTAL CODE
SIGNAL OR OTHER UNIT NO. OF TRANSPORT UNIT	TRAINING CERTIFICATE #
NAME OF DRIVER	

SPECIAL COMMODITY

SHIPPING NAME AND DESCRIPTION	PRIMARY CLASSIFICATION	SUB-CLASS	P.L.N. UN. OR NA	EMERGENCY E. VOL. UN. OR NA	PACKING GROUP	IF TRANSFERRED BY SHIP, AIR, RAIL SEE CLASS. PERM.	STATEMENT OF EMERGENCY RESPONSE PLAN REFERENCE # TELEPHONE #	MARKS BY VOLUME	# OF PROB.
1) METHYLENE CHLORIDE		9.2	1593	I	III			100ml	1
2) #2 ✓ DIST. H ₂ O BLANK									
3) #3 ✓ MECH MELL BLANK									
4) #4									
5) #5 (52) ✓ UMATAC FILTER BLANK									
6) (101) ✓ UMATAC 12/05/88									

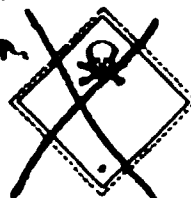
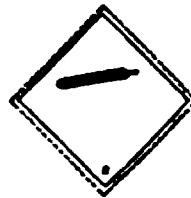
SPECIAL INSTRUCTIONS (e.g. CONTROL AND EMERGENCY TEMPERATURES, ANY REQUIREMENTS TO ENSURE STABILITY)

☐ ADDITIONAL DOCUMENTS ATTACHED

OR. NO.			
IN HOUSE EMERGENCY TELEPHONE NUMBER			
PROTECTIVE DIRECTION NUMBER		EQUIVALENT LEVEL OF SAFETY PERMIT NUMBER	
		PERMIT FOR EXCEPTION NUMBER	

PLACARDS REQUIRED (PLEASE INDICATE BY CROSSING OUT APPROPRIATE PLACARDS 1-6)

☐ LAST CONTAINED AS ABOVE



RECEIVED JUN 03 1988
49473-17
C.A.

DISTRIBUTION: ORIGINAL - CARRIER'S COPY PART 2 - CONSIGNOR'S COPY PART 3 - CONSIGNEE'S COPY PART 4 - TO STAY WITH TRUCK

TRADE SECRET

SENT BY:

7-14-88 5:25PM

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182

Characteristics of Triethylamine

Page 4

form over the eyes resulting in foggy vision. This eye condition will clear in two to three hours in fresh air (eye wash does not help) with no adverse after effects. The human nose is a very sensitive detector of TEA and most persons can detect TEA at levels below 1 ppm, i.e., at 25 ppm most personnel will leave the area.

Samples of the atmosphere in the vicinity of the Mini-B.E.S.T. dryer during six days of test runs (Jan. '75) showed a concentration of less than 1 ppm for 17 of the 24 samples taken. The maximum concentration obtained was 10 ppm (1-13-75) caused by a leak in the solvent still line to the concentrate tank about 3 feet from the sampling port.

Personnel who may be in direct contact with liquid or vaporous TEA should wear coverall goggles and/or an air supplied mask. Use of protective rubber gloves and provision of a safety shower and eye bath are recommended. Liquid TEA in the eyes will cause severe burns and clothing wet with TEA can also cause skin burns.

5. Biodegradability

TEA in Soil

94% TEA decrease in 20 days

99.6% TEA decrease in 95 days

TEA in Liquid Media

50% TEA decrease in 30 days

99.9% TEA decrease in 68 days.

1000

14.1 M3

Vapor Pressure

Vapor Pressure

1000

Fig. 1

TREHM AMINE

VAPOR PRESSURE

VS

TEMPERATURE

100

120

140

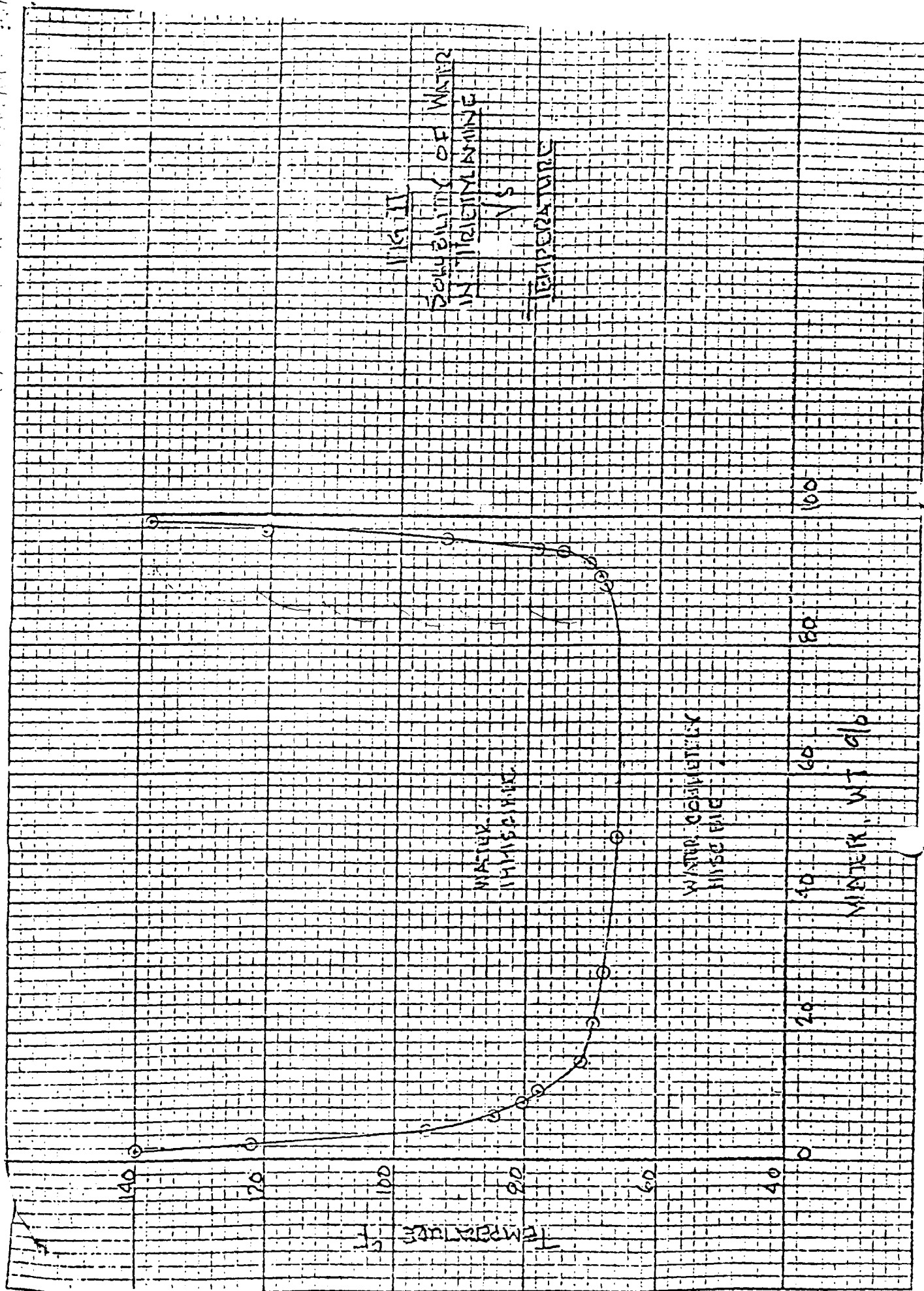
160

180

200

220

Lab 13: Solubility of Water in Nitrogen
 Date: 10/10/2019
 Name: [illegible]





RESOURCES CONSERVATION CO.

3101 N.E. Northup Way
Bellevue, Washington 98004
Telex: 350166 RCC SEA

October 15, 1987

COPY

Mr. David Pepson
Quality Assurance Officer
Land Disposal Restrictions Program (BDAT)
Office of Solid Waste
United States Environmental Protection Agency
WH-565A
401 M Street S.W.
Washington, D.C. 20460

Subject: The B.E.S.T.TM Process as BDAT for Petroleum Refining Wastes

Reference: 1. Subpart B - Schedule for Land Disposal Prohibition and
Establishment of Treatment Standards
40 C.F.R. § 268.10
2. 40 C.F.R. § 261.32.

Dear Mr. Pepson:

I am writing to provide data for evaluation of a solvent extraction technology - the B.E.S.T.TM process, which RCC has invented, developed, and placed in commercial use, for specification as BEST DEMONSTRATED AVAILABLE TECHNOLOGY for the listed petroleum refining wastes (K-048 to K-052), under the 1984 RCRA Amendment's "first third" list land disposal restriction regulations [SAR No. 2452]. We understand that you are currently completing technology evaluations in preparation for issuance of the proposed rule on this matter.

When residues from the B.E.S.T.TM process are evaluated under the TCLP, the results are entirely comparable to results from tests on incinerator ash. And like incinerators, our system can easily be optimized for even better TCLP performance by the addition of well demonstrated and commercially available procedures.

B.E.S.T.TM sludge treatment systems are resource recovery units that do not have high operational air emissions that are characteristic of incinerators. It has a lower cost by at least a factor of two. Finally, it recovers a commercially valuable oil product, while incineration is purely destructive.

RCC has already supplied EPA with complete data on the performance of the B.E.S.T.TM process in full-scale use at the General Refining Superfund Site in

Region IV. This letter contains further analysis of that data and also contains data relating specifically to B.E.S.T.TM sludge treatment process performance on the listed refining wastes. We will supply you with further data as it becomes available. We would be happy to consider performing further analysis or testing along any line that EPA might feel would be useful.


We know that there isn't much time until the scheduled issuance of the proposal on this matter. However, we hope you will be able to consider these comments and take them into account before the proposal is issued, or, failing that, that you would consider them as part of our comments on the proposal itself.

Our full analysis is contained in the attached memorandum. I know that you are already familiar with many of the details of the B.E.S.T.TM treatment process, however, we have included additional background information for the general reader.

Best regards.

Very truly yours,

RESOURCES CONSERVATION CO.


R. Reams Goodloe, Jr.
Attorney

Enclosure

cc: Mr. James R. Berlov, Chief
Treatment Technology Section

Mr. Stephen R. Weil, Chief
Land Disposal Restriction Branch